Marine Environmental Data Service

Observations from Current Meters Moored Over the Continental Shelf off Vancouver Island, 28 November 1974 to 8 April 1975, and Related Oceanographic and Meteorological Data

Adriana Huyer, Jean Gagnon and Stanley Huggett

TECHNICAL REPORT NO. 4

1976

Environment Canada
Fisheries and Marine Service

Environnement Canada
Service des pêches et des sciences de la mer

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ABSTRACT

Observations from five moored current meters were made at two locations (49°02'N, 126°14'W and 48°55'N, 126°31'W) over the continental shelf west of Tofino, Vancouver Island from 28 November 1974 to 10 February 1975 and again from 11 February to 8 April, 1975. Although the magnitudes of the speeds may be contaminated by mooring motion due to large surface waves, some qualitative conclusions can be drawn. Current fluctuations are greater at the mid-shelf than at the outer shelf, and some of the fluctuations at the outer shelf do not occur at mid-shelf. Currents at both locations are usually northward until 25 March, when a strong southward flow is first observed. Current fluctuations at the mid-shelf are largely barotropic and highly correlated with sea level, but only poorly correlated with wind observations from Tofino.

RÉSUMÉ

Des observations ont été faites à deux endroits (49°02'N, 126°14'W et 48°55'N, 126°31'W) par cing courantomètres amarrés au-dessus du plateau continental à l'ouest de Tofino, Ile de Vancouver, du 28 novembre 1974 au 10 febrier 1975, et encore du 11 février jusqu'au 8 avril 1975. Même si les grandeurs de vitesse peuvent être contaminées par le mouvement de l'amarrage dû au grandes ondes de surface, certaines conclusions qualitatives peuvent néanmoins être déduites. Les variations du courant sont plus fortes au centre du plateau qu'au large et quelques variations observées au large ne se produisent pas au centre. Les courants aux deux endroits se dirigent d'ordinaire vers le nord jusqu'au 25 mars, lorsque le flot prend notamment une direction sud. Les fluctuations du courant au centre du plateau sont largement barotropiques et fortement corrélatives au niveau de la mer; cependant une très faible corrélation seulement semble exister entre ces fluctuations et les vents observés à Tofino.

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INTRODUCTION

Current observations were made at two locations over the continental shelf west of Vancouver Island. The purpose of the observations was partly to aid in the prediction of surface currents; and partly to study current, sea level and wind variations with periods of several days, of the same type as observed off Oregon and Washington (Cutchin and Smith 1973, Huyer et al. 1975). The observations coincided with current observations made over the continental shelf off Washington and northern Oregon (by the University of Washington, from 11 January 1975 to 6 May 1975) and at 45° N off Oregon (by Oregon State University, from 27 January to 15 May 1975).

This data report presents the data from a) the moored current meters, including temperature; b) salinity-temperature-depth data collected when the array was moored and serviced; and c) wind, atmospheric pressure, sea level and wave observations from Tofino. Our purpose here is to present a summary of the data; much of it will be studied later in more detail.

THE INSTRUMENT ARRAY

Instruments were moored at two locations on the continental shelf: one about mid-shelf (MS) and the other at the outer edge of the shelf (OS) (Figure 1). There were three current meters on the mid-shelf array (at the top, bottom and middle), and two (top and bottom) on the outer shelf array. The instruments were moored by a taut wire from a single anchor and subsurface flotation. The shallowest subsurface float was about 2 m above the shallowest current meter at each mooring; it was intended to be 18 m below the surface. The moorings were deployed on 28 November 1974, serviced on 11 and 12 February 1975 and recovered on 8 April 1975.

Aanderaa current meters were used in the array. At a preset time interval of 30 minutes each measured speed, direction and temperature, and some measured pressure. Speed is measured by counting the number of turns of a Savonius rotor in the previous time interval; direction, temperature and pressure are measured instantaneously.

Two current meters malfunctioned during the first installation. At 45 m MS, direction data was almost never recorded in the compass sector between 80° T and 180° T; currents in this direction were erroneously attributed to some other (unknown) direction. At 90 m MS, a total of 6153 instead of 3558 samples were made; the sampling interval appears to have been regular most of the time, but was apparently irregular some of the time. Hence, only qualitative results are available for this depth. Both malfunctions were detected and corrected when the instruments were serviced on 11 February 1975.

Schematics of the current meter array (Figure 2) show which parameters were successfully recorded during each installation.

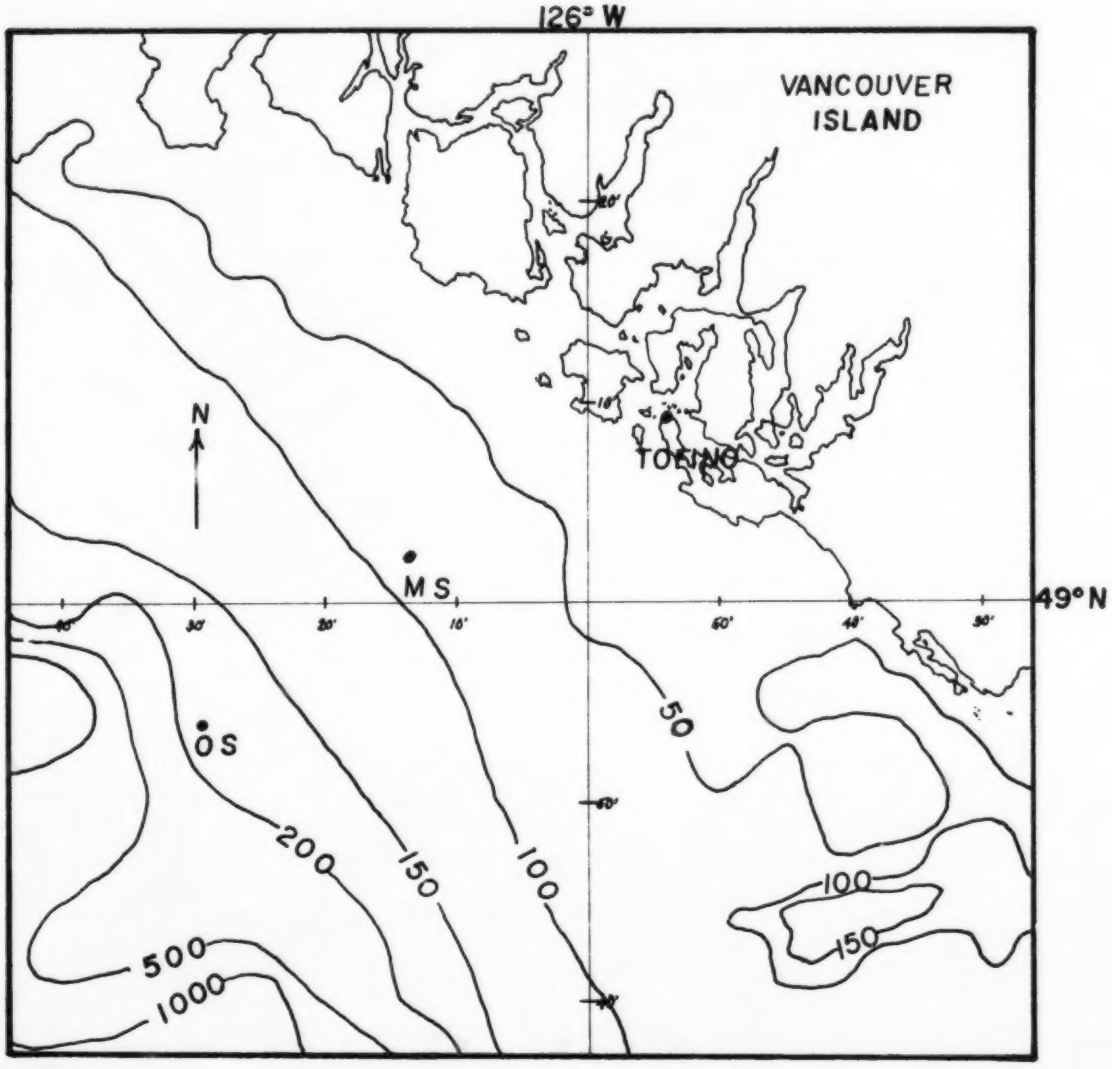

Figure 1

Location of current meter arrays moored over the continental shelf west of Vancouver Island, and bathymetry (depth in meters).

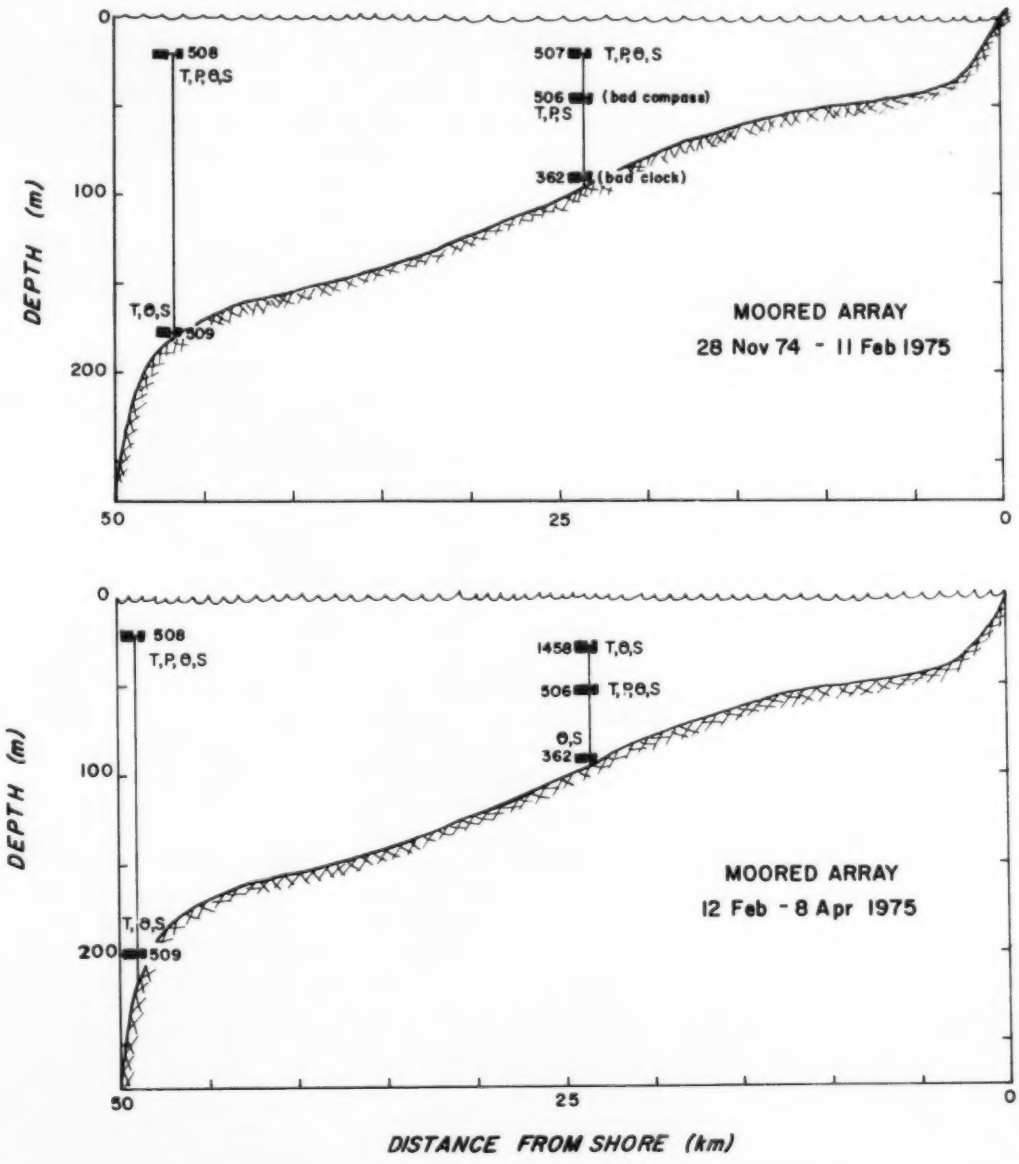

Figure 2

Schematics of the current meter array giving instrument numbers and showing which parameters were successfully recorded during each installation: T for temperature, P for pressure, S for speed and θ for direction.

DATA PROCESSING

The Aanderaa current meters record a number between 0 and 1023 on magnetic tape for each parameter: a reference voltage, temperature, pressure, direction and the rotor turn count. The rotor count is incremental, and two consecutive readings are required to compute the speed. The data were translated from the Aanderaa tapes to computer compatible tape. For temperature, pressure and speed we used the manufacturer's calibration; compasses are calibrated locally. No temperature calibration data was available for instrument no. 362. Obvious anomalies were replaced by linearly interpolated values calculated from their nearest neighbours; the anomalies were detected from time series plots of each parameter.

Anomalous speed data occurred in pairs; errors resulted from recording 1023 in the rotor count position instead of the actual value. The subsequent rotor count would still be correct, so the correct average speed of the two intervals could be obtained. Such speed errors were infrequent in most of the current records. They were more frequent in the data from meter 506 during both the first and second installations (78 out of 3558 and 34 out of 2653 data points, respectively). They were very frequent at 20 m OS between 29 December 1974 and 7 January 1975, but rare in the remainder of the record.

Anomalous direction data were detected by plotting current components after the speed had been edited, and replaced by interpolating between the previous and subsequent direction values. No attempt was made to correct the data for the compass malfunction of instrument 506 during the first installation. Anomalous direction values were more common at shallow depths than near the bottom.

Anomalous pressure values occurred frequently at 20 m OS during the first installation. Some were removed by editing, but most were concentrated in two periods, 16 to 21 December 1974 and 31 December 1974 to 5 January 1975. These appeared to result from recording errors, as most of the calculated values were physically impossible (exceeding 300 db).

From the edited speed and direction data we computed half-hourly eastward and northward components, and orthogonal "onshore" and "alongshore" components. We defined the "alongshore" direction in terms of the local isobath orientation, which we took to be 323° T at MS and 338° T at OS. The onshore component is positive toward shore, and the alongshore component is positive when it is poleward.

OBSERVATIONS

A) FROM MOORED ARRAY

Table 1 summarizes the results of the first installation of the moored array. Data from the deep MS current meter have not been included; because of the irregular sampling interval, results here are qualitative only.

Nominal depths of the current meters were estimated from a knowledge of the mooring wire lengths, and the depth of the bottom. The pressure data should be an independent estimate of the instrument depth. Mean pressure and nominal depth agree well at 45 m MS, but not as well for the shallow current meters. There is some doubt about the pressure calibrations but they are not likely to be off by more than 10 m. This indicates the shallowest current meters, and certainly the subsurface floats above them, were within the zone of wave action at least part of the time. The resulting mooring motion may have caused fluctuations of the current meter vanes, and almost certainly led to artificially high current speed (see e.g. Halpern and Pillsbury 1975, Gould 1972).

The temperature of the near surface water is slightly higher at MS than at OS. At MS, water at mid-depth is somewhat warmer than near the surface.

Both the mean speed and its standard deviation were higher at the shallower current meters. The standard deviation of the speed is less than that of any of the components, indicating that the current is largely rotary. Statistics for the first installation indicate that the mean **onshore** flow was greatest at 20 m OS, and smallest at 180m OS. The mean **alongshore** flow was poleward at each of the four current meters; smallest at 180 m OS and greatest at 20m MS. Statistics from the second installation (Table II) show similar results. Again, the offshore current meter has a mean pressure less than expected from the nominal depth. The mean pressure measured at the middle current MS mooring is greater than expected. Speed decreases with depth in both the mean and standard deviation. The mean flow is onshore at the shallow current meters, and offshore near the bottom. The mean alongshore flow is poleward at all current meters, and decreases with depth.

Table I. Statistics of observations from the moored current meters, first installation. Alongshore components are directed towards 338° T at OS, and 323° T at MS, and onshore components are toward 68° T and 53° T respectively. (Meter 362 omitted due to clock malfunction). First and second modes indicate the values at which the histogram peaks occur.

Location		OS(48° 53.8' N, 126° 29.7' W)		MS(49° 02.1' N, 126° 14.4' W)	
Instrument Number		508	509	507	506
Nominal Depth (m)		20	180	20	45
Time, Date of First Reading		2230 UT 28 Nov. 1974	2230 UT 28 Nov. 1974	2000 UT 28 Nov. 1974	2000 UT 28 Nov. 1974
Time, Date of Last Reading		2100 UT 11 Feb. 1975	2100 UT 11 Feb. 1975	2230 UT 10 Feb. 1975	2230 UT 10 Feb. 1975
Data Interval (min.)		30	30	30	30
Number of Observations		3598	3598	3558	3558
Temperature (C):					
(Fig. 4a)	minimum	7.33	6.14	6.95	7.20
	maximum	11.19	7.68	10.18	10.30
	mean	8.86	7.16	8.74	9.04
	std. dev.	0.83	0.30	0.93	0.88
Pressure (db):					
(Fig. 3)	minimum	5.5, 3.9+	-	13	40
	maximum	19.8, 30.8+	-	23	51
	mean	7.3, 6.5+	-	16	45
	std. dev.	1.5, 1.1+	-	12	1
Speed (cm/sec):					
	minimum	9.6	1.5	8.9	6.4
	maximum	81.3	45.5	91.0	81.3
	mean	34.1	12.4	35.9	27.1
	std. dev.	10.1	6.1	13.6	11.0
Direction (° T)					
	first mode	335	305	320	(305)*
	second mode	25	125		
Eastward Component (u) (cm/sec):					
	minimum	-67.1	-40.0	-74.1	(-65.5)*
	maximum	49.1	24.4	39.5	(25.8)*
	mean	- 7.3	- 3.8	-14.5	(-16.3)*
	std. dev.	20.3	10.2	19.5	(15.7)*
Northward Component (v) (cm/sec):					
	minimum	-51.6	-20.7	-48.0	(-32.5)*
	maximum	80.2	28.7	81.6	(60.8)*
	mean	20.1	1.2	20.7	(10.6)*
	std. dev.	19.8	8.4	21.4	(15.3)*
Onshore Component (u') (cm/sec):					
(Fig. 5a)	minimum	-67.6	-31.8	-44.5	(-44.4)*
	maximum	56.7	23.2	45.1	(33.8)*
	mean	7.5	- 3.1	0.9	(- 6.7)*
	std. dev.	20.3	8.9	15.4	(13.1)*
Alongshore Component (v') (cm/sec):					
(Fig. 5b)	minimum	-44.9	-22.2	-43.9	(-31.0)*
	maximum	73.3	37.1	89.4	(80.8)*
	mean	21.4	2.6	25.2	(18.3)*
	std. dev.	19.8	9.8	24.5	(17.6)*

*These values are subject to error because of a compass malfunction.

+Values are for the first 972 and last 1796 points respectively. Remainder of pressure record is of poor quality.

Table II. Statistics of observations from the moored current meters, second installation. For orientation of onshore and alongshore components see Table I.

Location		OS(48° 55.5' N, 126° 32.0' W)		MS(49° 02.0' N, 126° 14.4' W)		
Instrument Number		508	509	1458	506	362
Nominal Depth (m)		22	200	29	53	91
Time, Date of First Reading		2300 UT 12 Feb. 1975	2300 UT 12 Feb. 1975	1900 UT 11 Feb. 1975	1900 UT 11 Feb. 1975	1900 UT 11 Feb. 1975
Time, Date of Last Reading		0200 UT 8 Apr. 1975	0200 UT 8 Apr. 1975	0100 UT 8 Apr. 1975	0100 UT 8 Apr. 1975	0100 UT 8 Apr. 1975
Data Interval (Min.)		30	30	30	30	30
Number of Observations		2599	2599	2653	2653	2653
Temperature (C):						
	minimum	7.31	5.80	6.70	7.49	-
(Fig. 4b)	maximum	8.82	7.63	8.54	8.56	-
	mean	7.91	6.85	7.75	8.04	-
	std. dev.	0.23	0.33	0.22	0.19	-
Pressure (db)						
(Fig. 3)	minimum	11.1	-	-	52.5	-
	maximum	20.5	-	-	62.0	-
	mean	12.9	-	-	59.1	-
	std. dev.	1.1	-	-	0.7	-
Speed (cm/sec):						
	minimum	6.6	1.5	6.4	3.4	2.0
	maximum	87.2	62.3	101.4	72.7	47.0
	mean	24.3	10.9	35.3	20.1	14.6
	std. dev.	9.5	7.8	16.4	10.3	6.1
Direction (° T)						
	first mode	335	285	335	335	275
	second mode	25	165	115	135	
Eastward Component (u) (cm/sec):						
	minimum	-79.1	-59.3	-81.4	-53.6	-38.4
	maximum	43.7	23.3	75.8	58.4	34.8
	mean	- 1.3	- 5.7	- 8.1	- 3.5	- 2.3
	std. dev.	17.3	9.6	23.8	14.3	11.9
Northward Component (v) (cm/sec):						
	minimum	49.6	-19.4	-63.8	-49.5	-29.0
	maximum	73.4	34.4	83.2	60.1	39.8
	mean	7.3	1.8	16.0	5.2	0.0
	std. dev.	18.1	7.3	25.0	16.4	10.2
Onshore Component (u') (cm/sec):						
(Fig. 6a)	minimum	-59.7	-47.8	-48.7	-29.7	-37.7
	maximum	36.4	24.4	51.0	41.2	27.4
	mean	1.5	- 4.6	3.1	0.3	- 1.9
	std. dev.	15.4	9.3	16.2	9.6	10.0
Alongshore Component (v') (cm/sec):						
(Fig. 6b)	minimum	-53.8	-19.2	-76.2	-54.6	-27.9
	maximum	83.7	40.0	97.3	72.6	46.8
	mean	7.2	3.8	17.7	6.3	1.4
	std. dev.	19.8	7.7	30.5	19.5	12.1

Pressure

Time series of the pressure observations are shown in Figures 3a and 3b. Pressure variations can occur because of fluctuations in sea level (mainly tidal) and because of mooring motion. Errors, which appear to be due to faulty recording, occur in the pressure record from 20 m OS, first installation. Some were replaced with interpolated values, but most remain in the data. Except for these errors, the pressure data show fairly regular fluctuations. They appear to be mostly tidal, with a maximum range of about 4 db and a minimum range of about 2 db. Resolution of the pressure data is 0.8 db.

The record from 22 m OS, February to April, shows a slow decrease in pressure during the first day and a half. Current speeds were very high (about 90 cm sec^{-1}) on 12 and 24 February (see Figure 6b) and it seems likely the strong current caused the mooring to tilt. When the current weakened, the mooring was more nearly vertical, and the instrument remained at about the same depth during the remainder of the record.

Temperature

Time series of the half-hourly temperature observations are shown in Figures 4a and 4b. There is almost no temperature difference between the top and middle current meters on the mid-shelf mooring during some periods: 28 November to 19 December 1974, 7 to 10 January 1975, and 1 to 5 February 1975 (Figure 4a). During these periods, the surface mixed layer seems to extend down to the depth of the middle current meter (about 45 m). During the second installation (Figure 4b) small differences are observed only for very short periods (23 to 24 February, 21 to 22 March, 26 March and 4 to 5 April 1975). During the remainder of the time at MS, the temperature at the shallow current meter is slightly lower than at mid-depth. At both current meters the temperature gradually increases from 5 December to 18 December 1974 and then decreases, more rapidly, until 12 January 1975. Fluctuations with periods of several days occur from 12 January on. The lowest temperature occurs in mid-January and no significant warming is observed before the end of the records in early April.

The first temperature record from 20 m OS, shows frequent erroneous values which are probably due to faulty recording, since they occur during the same periods as frequent speed and pressure errors. The long term temperature trends here are similar to those at mid-shelf, with a maximum observed about 19 December. The outer shelf temperature fluctuations are significantly different from those observed at MS. From 20 December to about 1 January the near surface temperature is usually higher at OS than at MS, and fluctuations seem to be inversely correlated.

Near the bottom at the outer shelf, the temperature frequently shows diurnal fluctuations and, occasionally, semi-diurnal fluctuations. There are few fluctuations with periods of several days. The lowest temperatures are observed at the end of March and early April. The temperature is high ($\approx 7.5\,^{\circ}$C) in the last half of December, 6 to 7 February and 21 to 25 March.

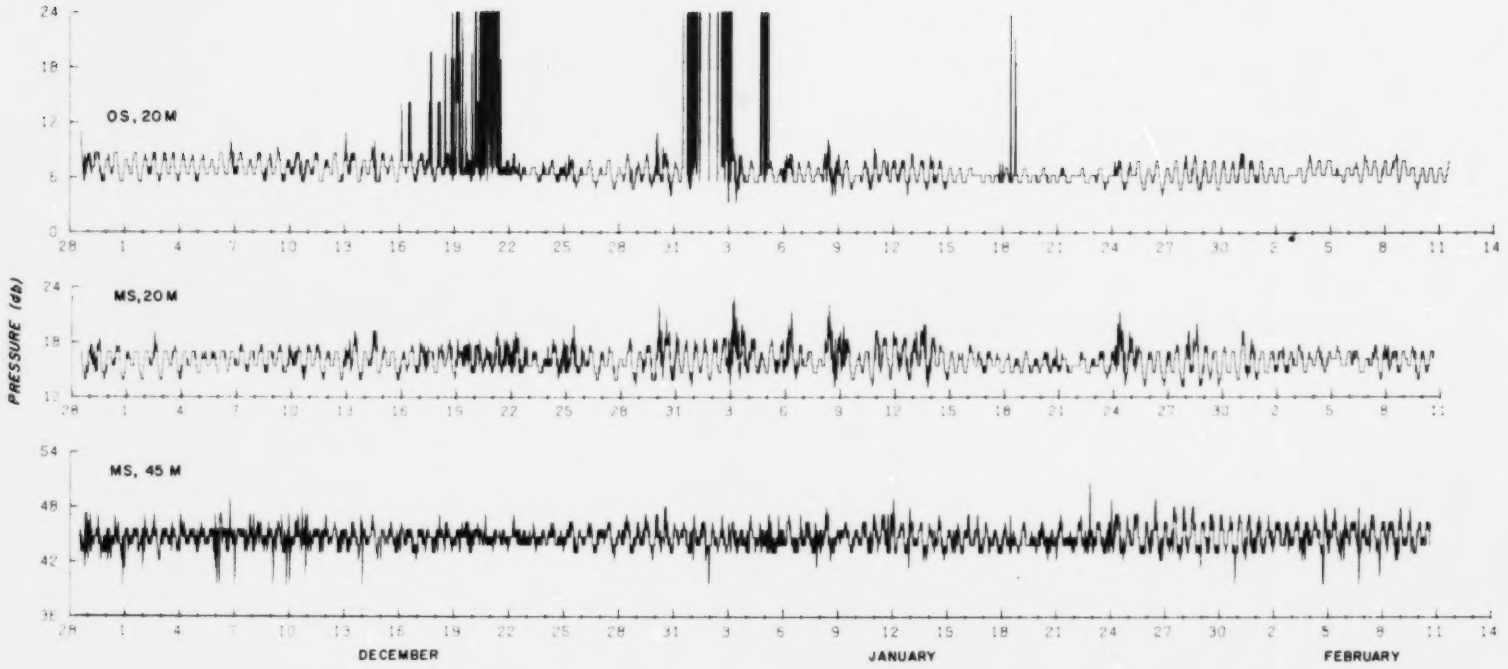

Figure 3a

Time series of half-hourly pressure observations from the moored current meters, 28 November 1974 to 11 February 1975. Tick marks on the time axis occur at 0800 UT (0000 PST) of each day.

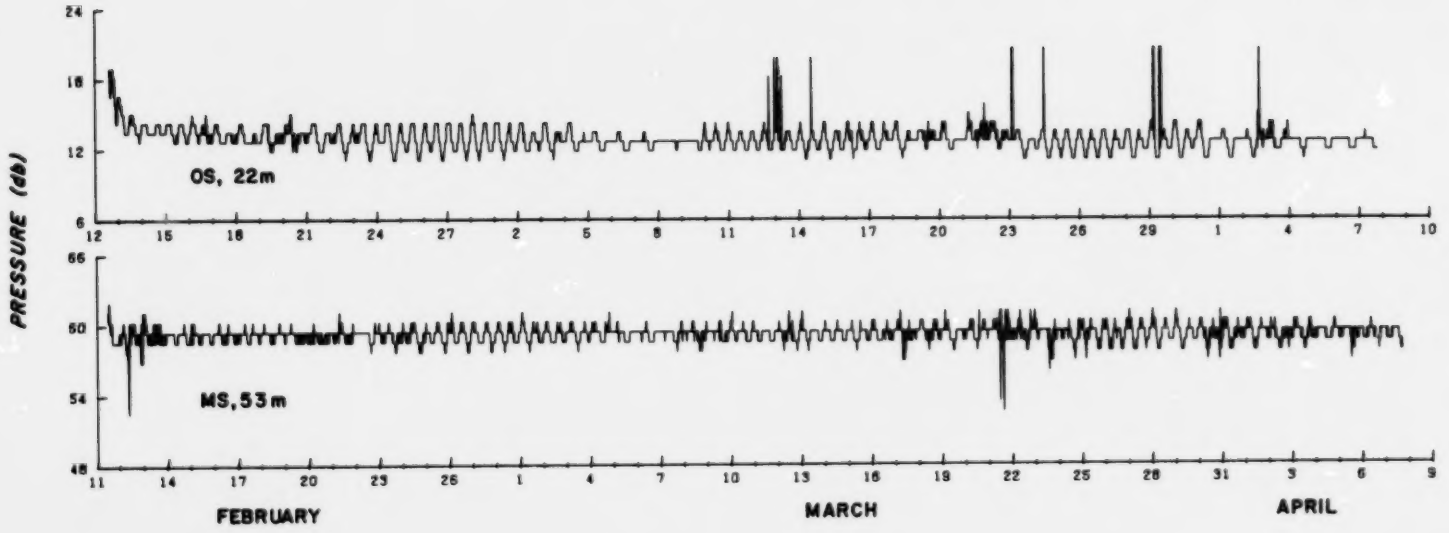

Figure 3b

Time series of half-hourly pressure observations from the moored current meters, 11 February MS and 12 February OS 1975 to 8 April 1975. Tick marks on the time axis occur at 0800 UT (0000 PST) of each day.

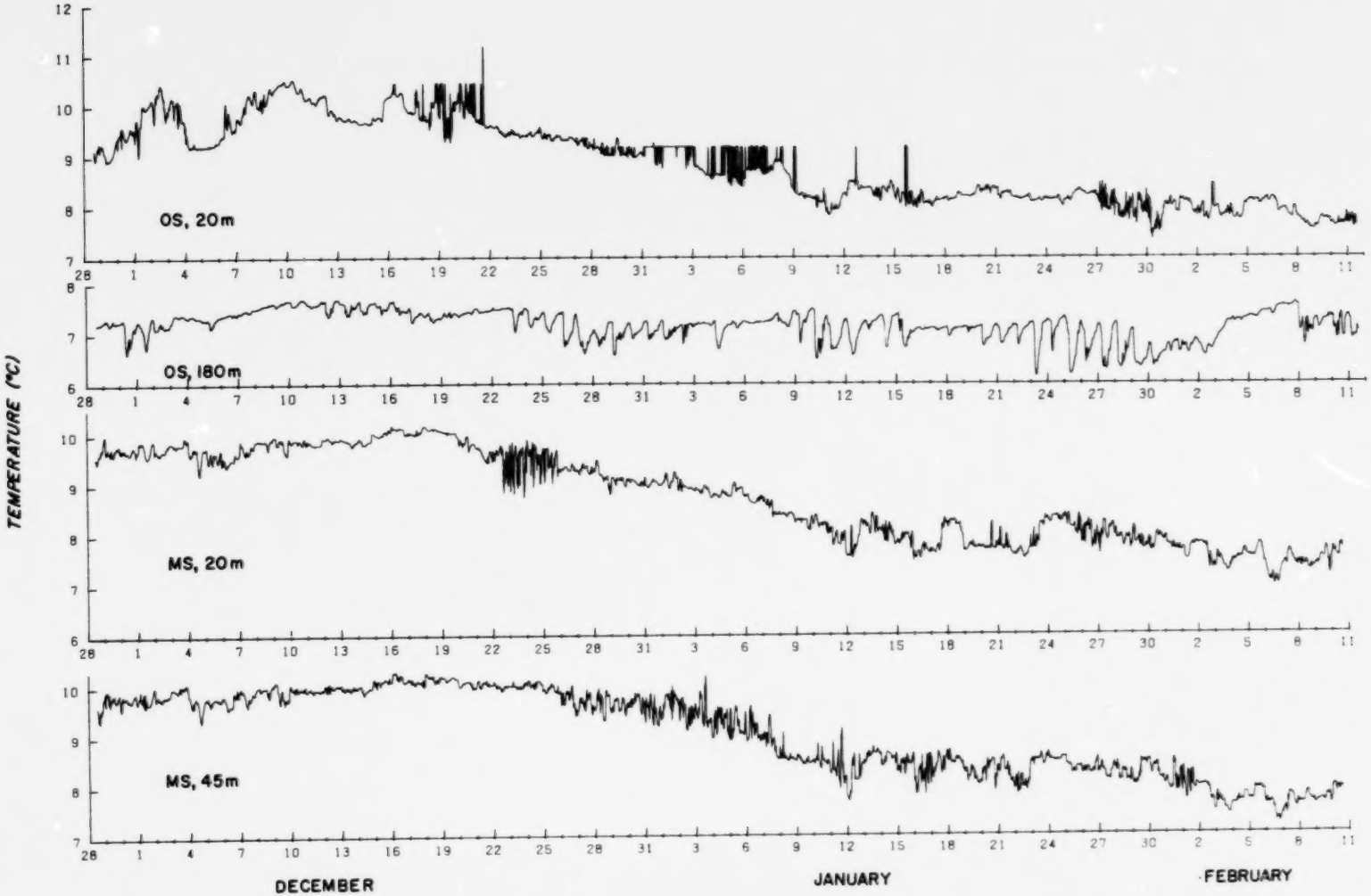

Figure 4a

Time series of half-hourly temperature observations from the moored current meters, 28 November 1974 to 11 February 1975. Tick marks on the time axis at 0800 UT of each day.

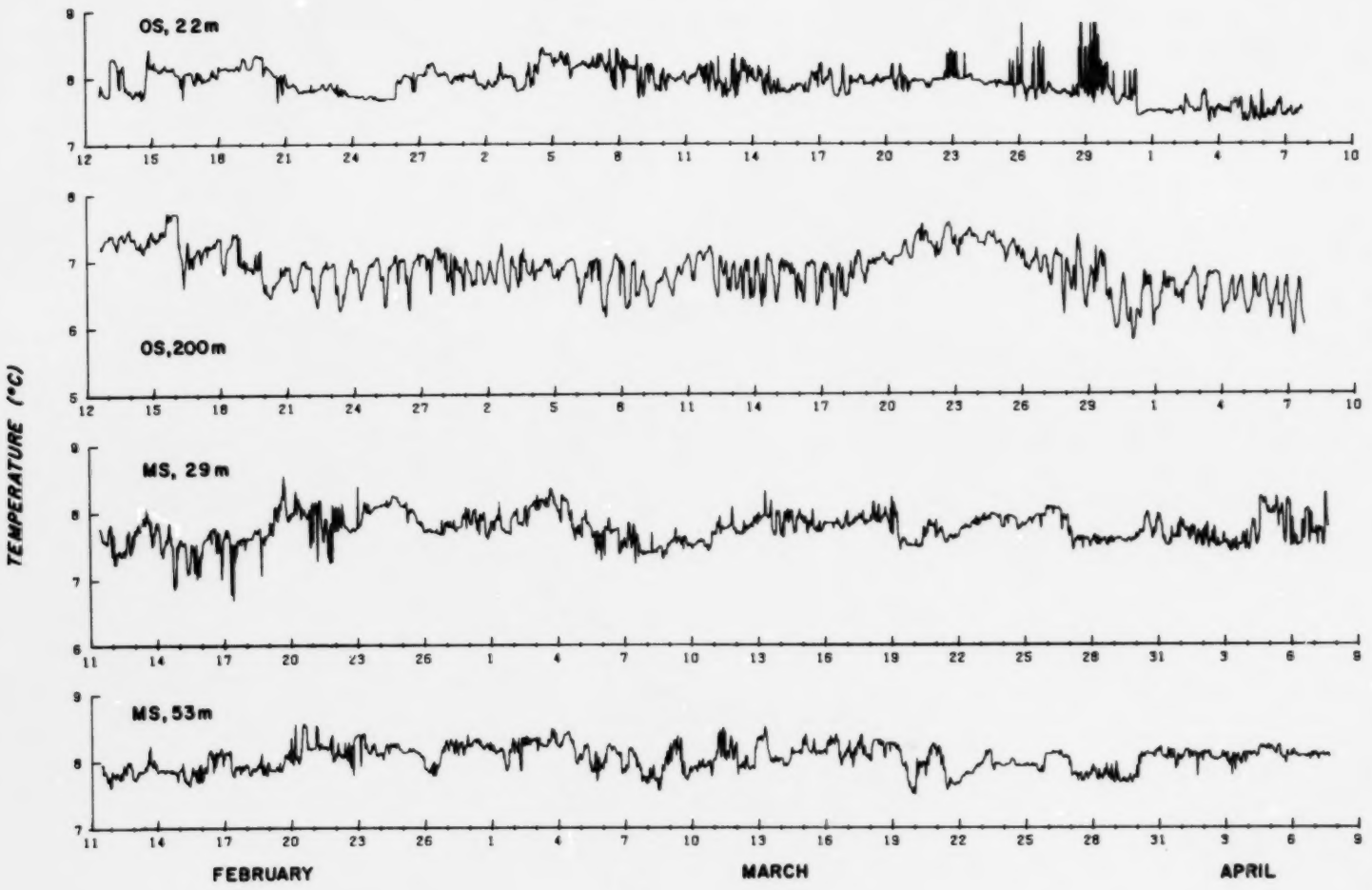

Figure 4b

Time series of half-hourly temperature observations from the moored current meters, 11 February MS and 12 February OS 1975 to 8 April 1975. Tick marks on the time axis at 0800 UT of each day.

Currents

Time series of the onshore and alongshore components of the current observations are shown in Figures 5 and 6. The data from 45 m MS have been included for the first installation even though the compass did not record when the current direction was not in this quadrant (for example, 28 November to 12 December). All current observations are quite noisy except at the deepest current meters. This noise is probably due to mooring motion induced by wave action and the Aanderaa sampling method of measuring mean speed and instantaneous direction. Wave data from Tofino frequently showed peak energy at periods exceeding 12 seconds (Figure 12) corresponding to wave lengths greater than 400 m. All current records show tidal fluctuations (for tidal analysis see Appendix). These are also strong in the alongshore component (the maximum range of tidal velocities is about 50 cm sec^{-1}) but lower frequency fluctuations are stronger, and there is a significant poleward mean flow at all current meters.

The flow at MS has a net poleward component until about 18 December, consistent with the warming trend observed during that period (Figure 4). There is little poleward transport between 19 December and 1 January when cooling is observed. The temperature continues to decrease, in spite of a northward flow, for the reminder of the records, except for several brief periods. Local cooling is apparently stronger than the warming by poleward advection during these months.

Near the bottom OS, warming trends are observed (Figure 4) whenever there is prolonged northward flow: 3 to 11 December, 2 to 7 and 12 to 15 February, 9 to 11 and 18 to 23 March. At this depth, the influence of northward advection apparently outweighs local cooling.

Progressive vector diagrams (PVD's) of the current observations are shown in Figures 7 and 8. The PVD's from the second installation (Figure 8) all show poleward flow which was seen at the first installation (Figure 7). The MS mooring has three obvious reversals centred on March 9 to 14, March 24 to 25 and April 3 respectively, whereas the OS mooring has two major flow direction changes: one starting February 18 and ending on February 28 and the other centred on March 25. A closer look at the MS direction change between March 9 to 14 shows that the 91 m MS change precedes the 53 m MS which in turn precedes the 29 m MS change indicating that the whole water column is reversing direction from the bottom first. The current also veers with depth at the reversals; the current at 53 m MS is directed along the local isobath whereas the current at 29 m MS is rotated toward shore and the current at 91 m MS is rotated away from shore indicating a downwelling type of circulation pattern. This flow veering is not as obvious on the March 24 to 25 reversal at MS but is clearly visible for both changes at the OS mooring. The final direction change at MS occurs on April 3 but our record is too short to notice any long term trends. The direction changes occur at the MS mooring prior to the OS mooring so that the dynamics of the circulation changes appear to originate nearest the coastline first. It is significant to note that the most obvious and complete reversal of current occurs near March 25 from a general northward flow to a southward flow of the whole water mass along the coast. It is difficult to ascertain whether an opposite reversal occurs on April 3, because of our insufficient length of data.

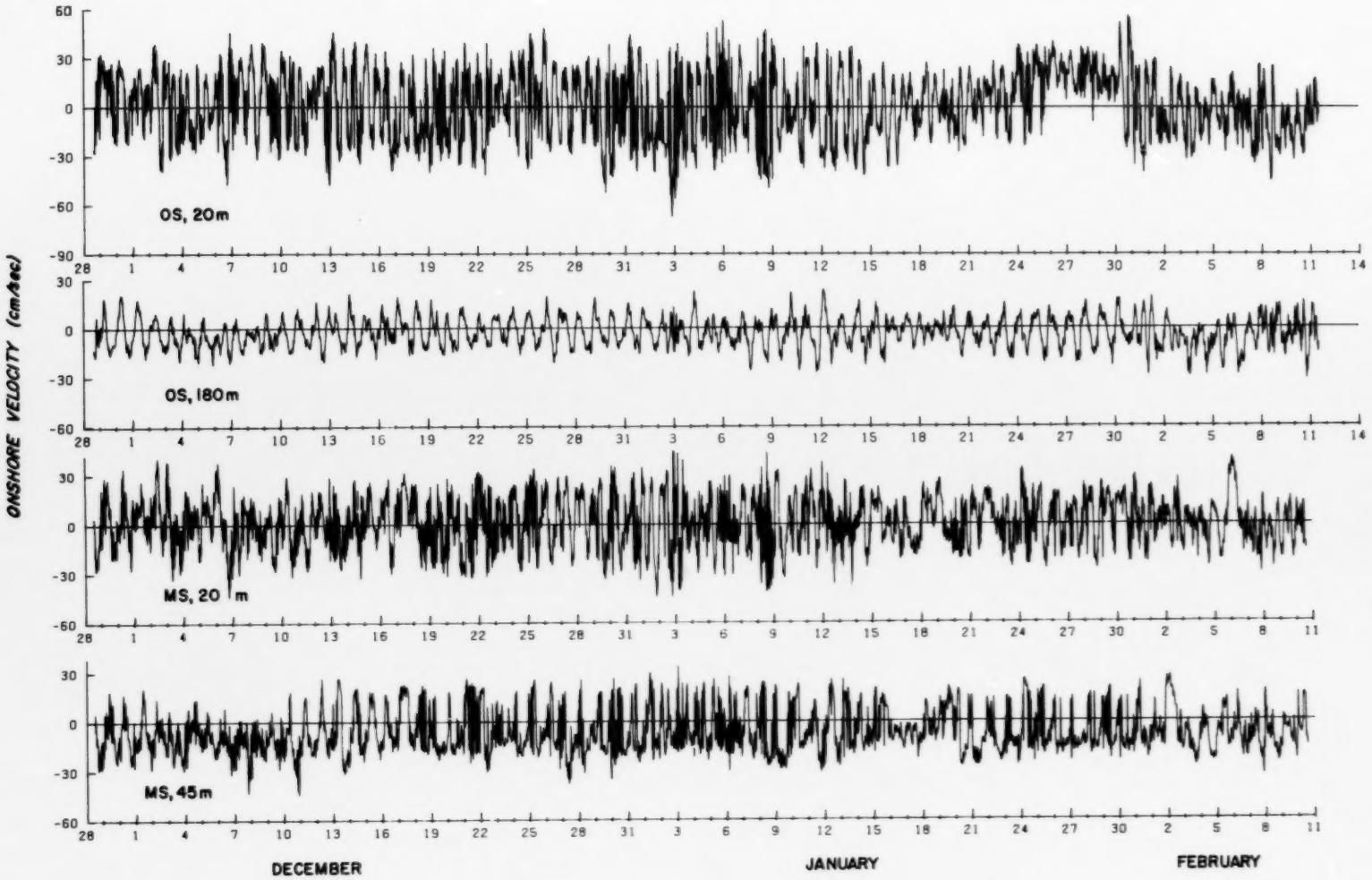

Figure 5a

Time series of half-hourly current observations, first installation 28 November 1974 to 11 February 1975 ONSHORE component. Tick marks on the time axis occur at 0800 UT. Data at 45 m, MS are subject to a compass malfunction; see text.

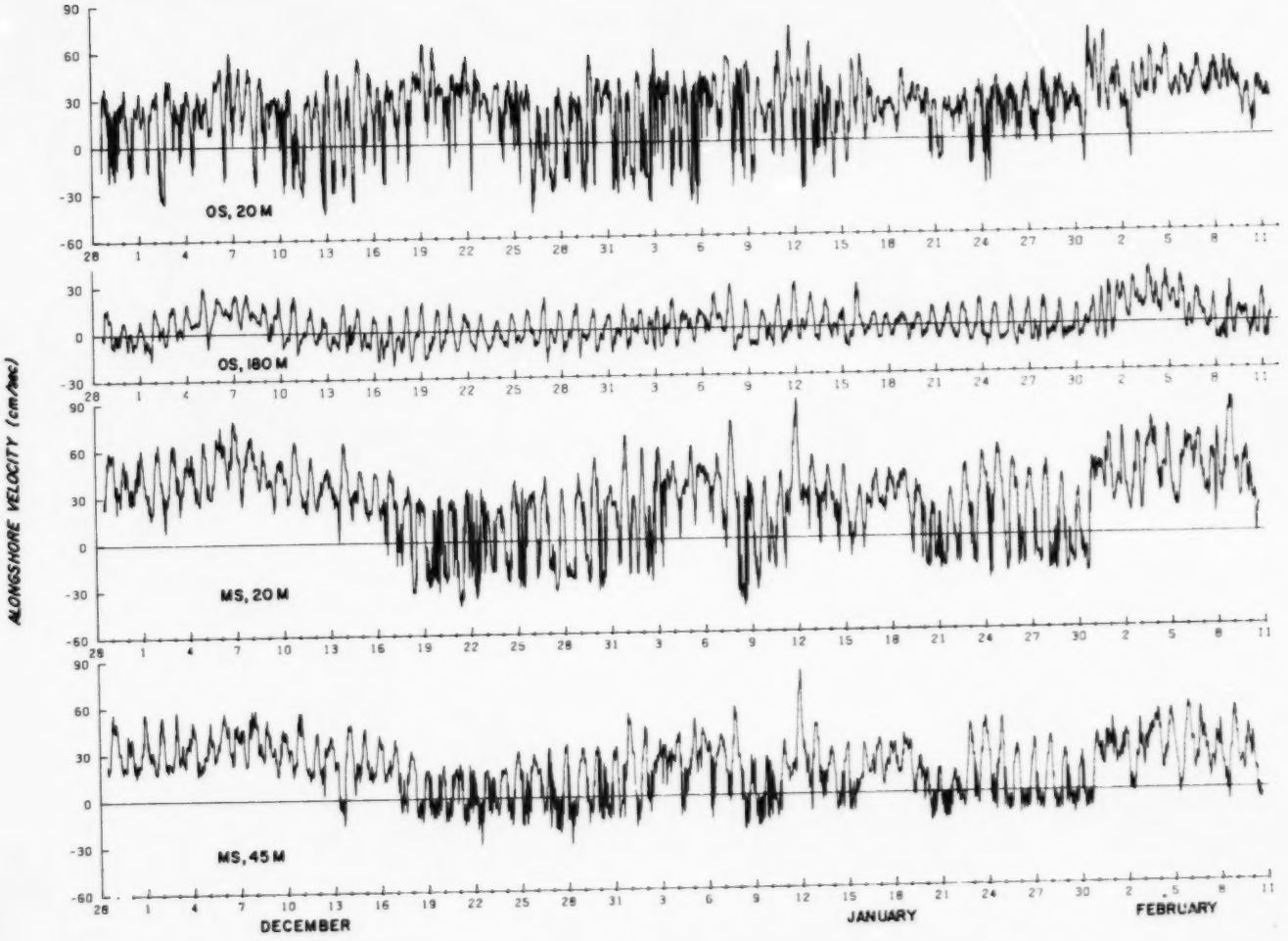

Figure 5b

Time series of half-hourly current observations first installation (28 November 1974 to 11 February 1975) ALONGSHORE component. Tick marks on the time axis occur at 0800 UT.

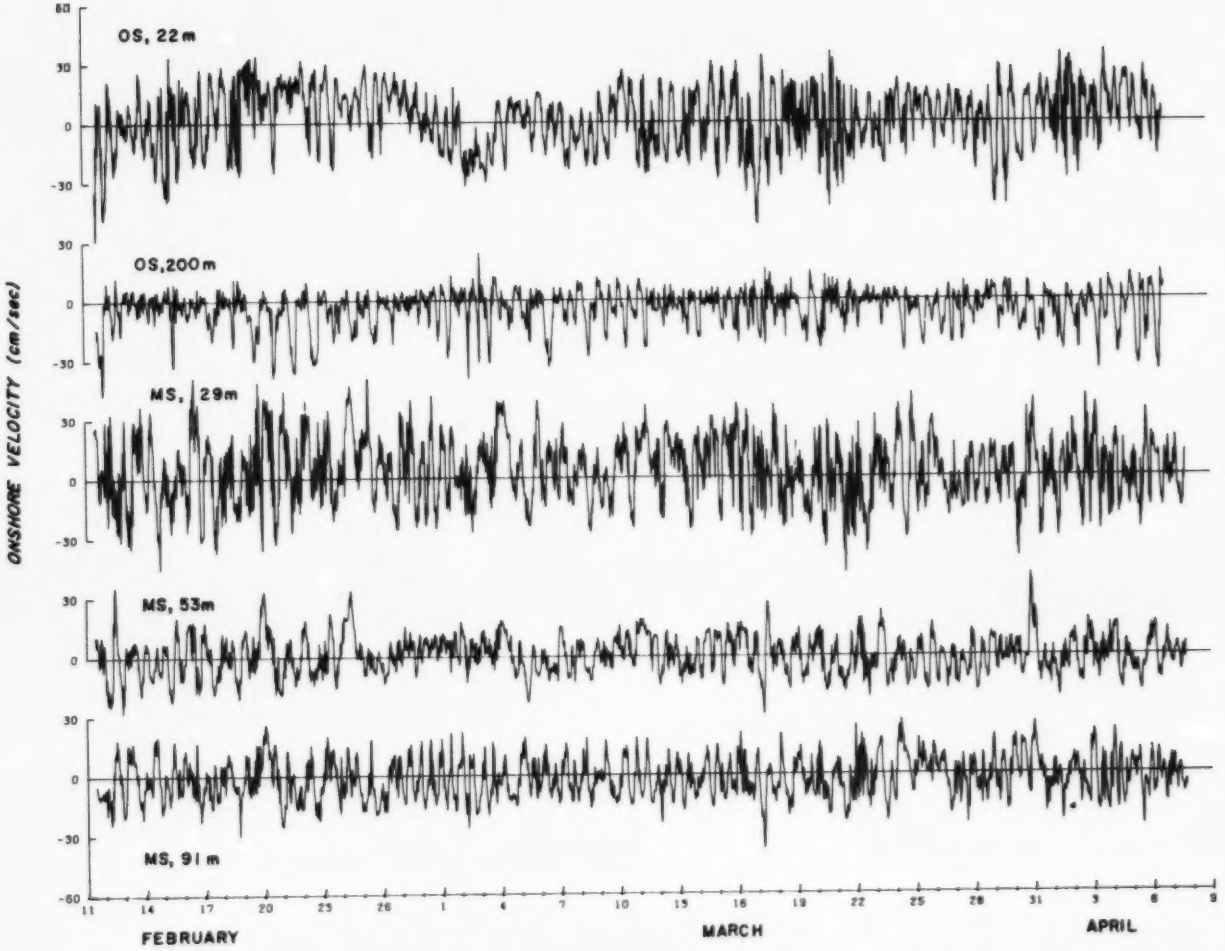

Figure 6a

Time series of half-hourly current observations, second installation (11 February MS and 12 February OS 1975 to 8 April 1975) ONSHORE component. Tick marks on time axis occur at 0800 UT.

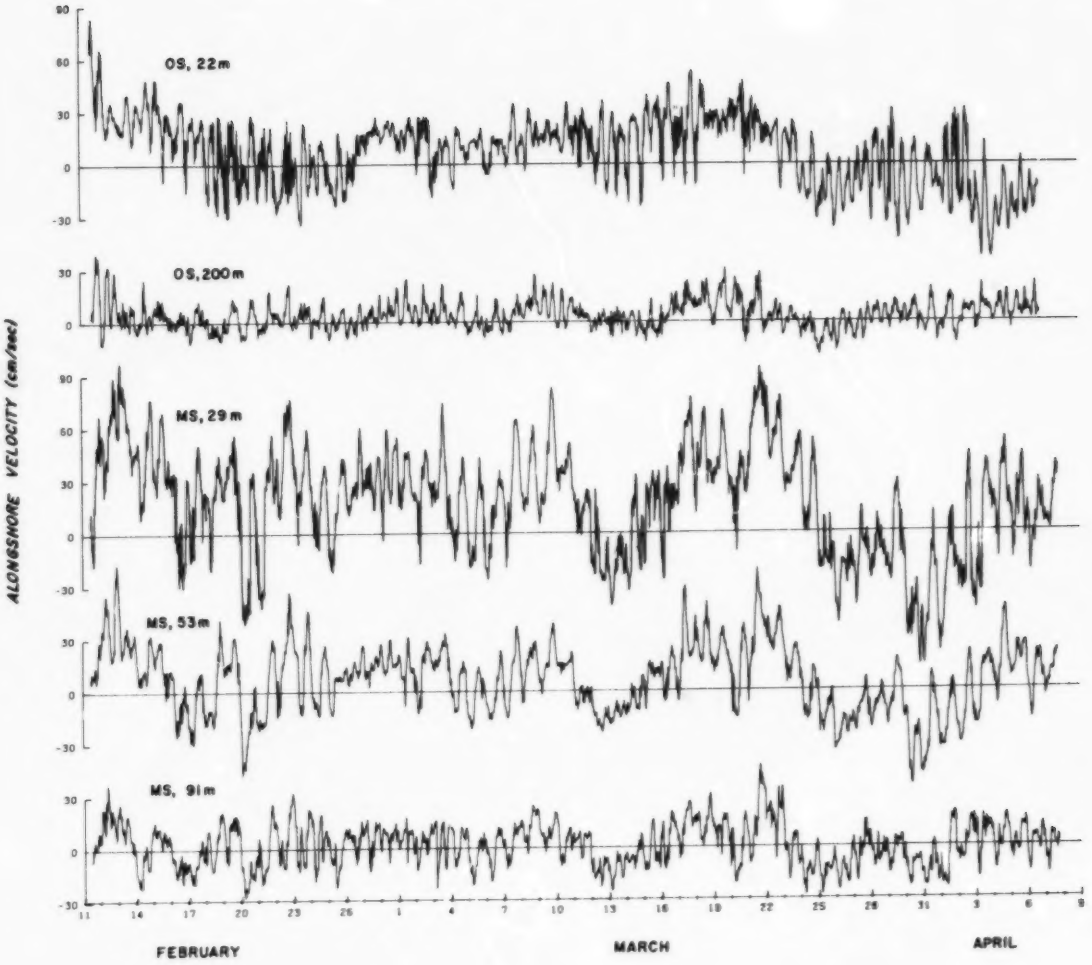

Figure 6b

Time series of half-hourly current observations, second installation (11 February MS and 12 February OS 1975 to 8 April 1975) ALONGSHORE component. Tick marks on time axis occur at 0800 UT.

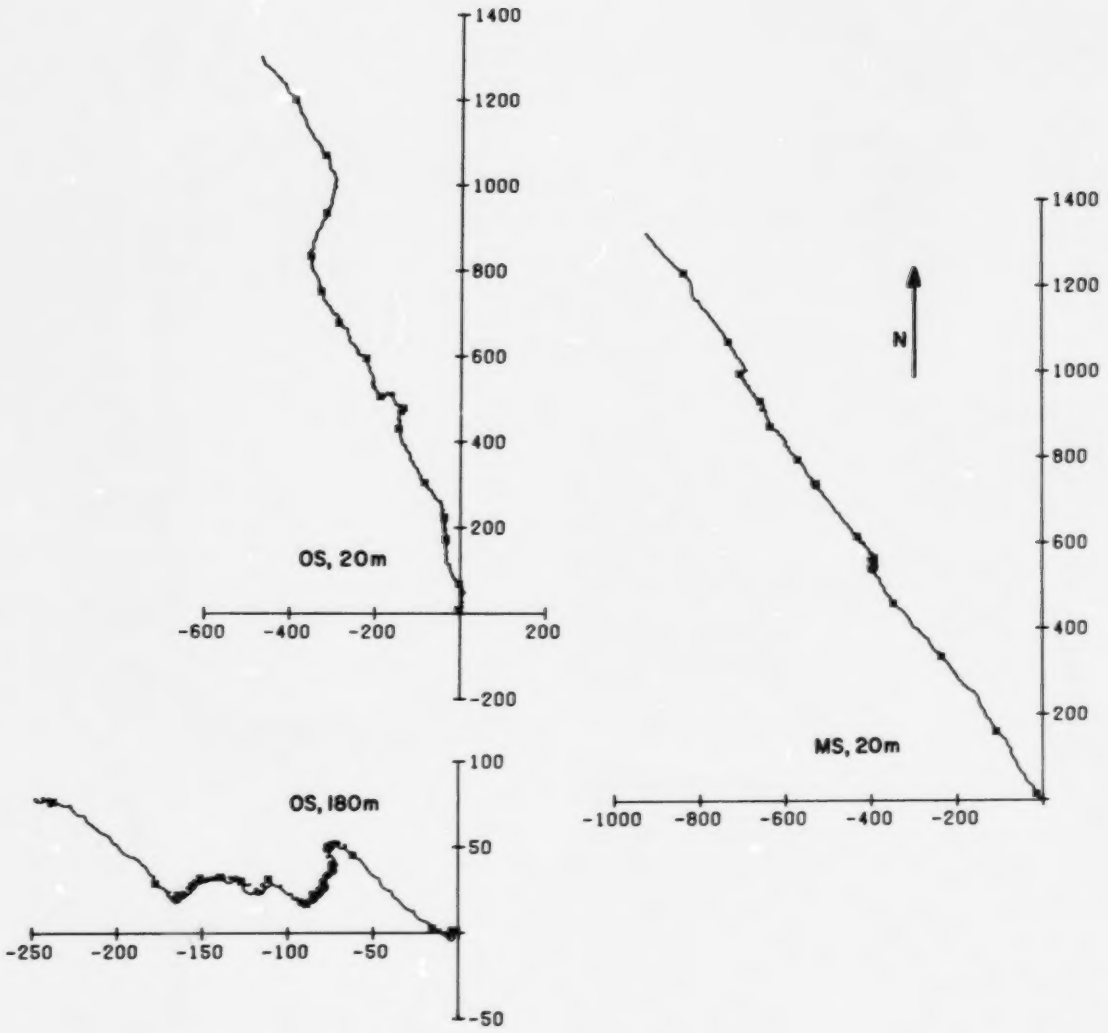

Figure 7

Progressive vector diagrams of current observations, 28 November 1974 to 11 February 1975. Distances in km. Stars occur at 0800 UT, every fifth day.

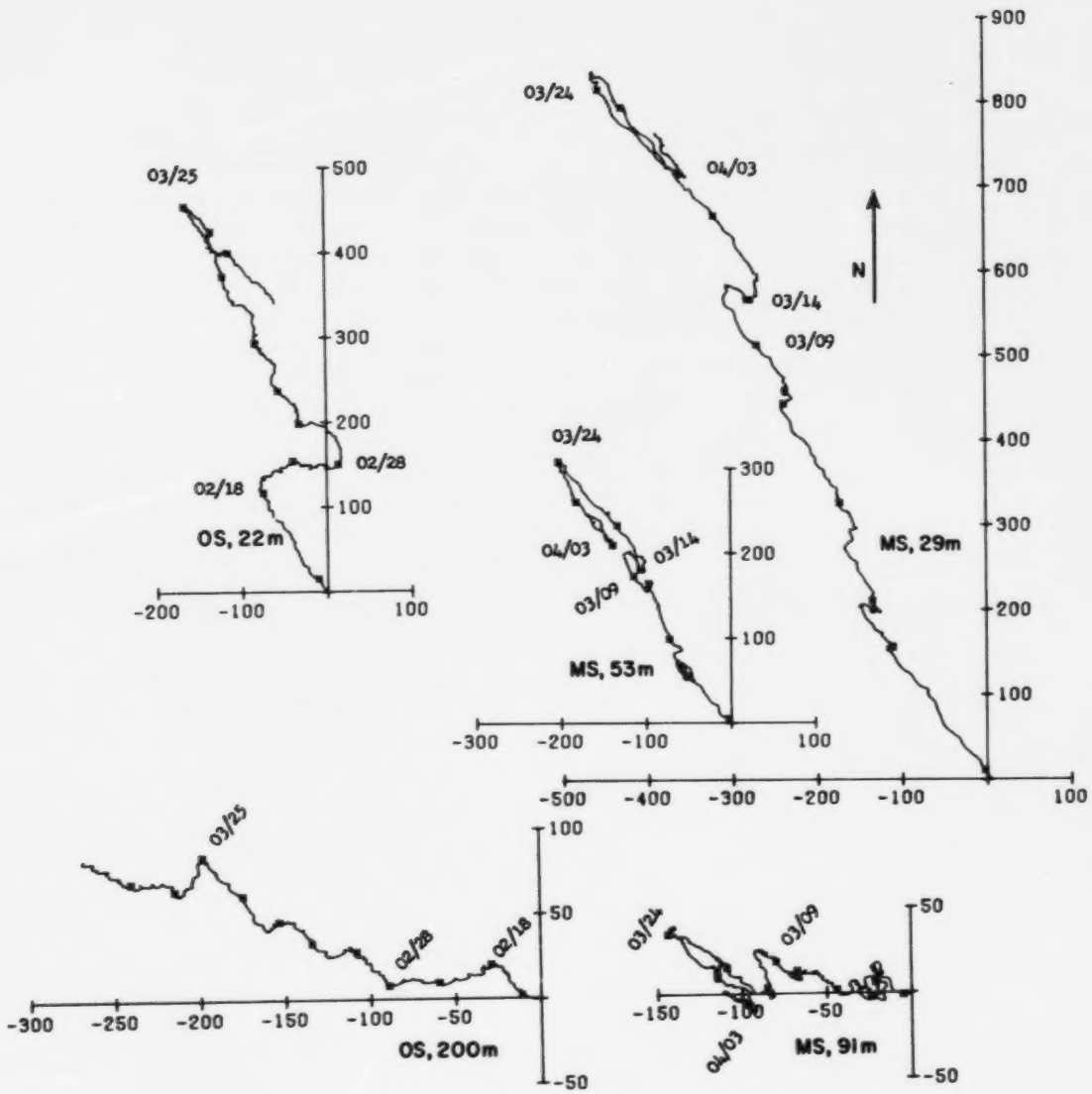

Figure 8

Progressive vector diagrams of current observations, 11 February MS and 12 February OS to 8 April 1975. Distances in km. Stars occur at 0800 UT, every fifth day.

B) STD OBSERVATIONS

A Bissett-Berman salinity-temperature-depth system was used to make oceanographic observations along an offshore line parallel to the current meter array when it was installed and serviced; it was out of order when the array was recovered in April. The system records analog data on graph paper which was read by hand. In November the system worked well, and both temperature and salinity data were obtained at nine stations over the shelf and one over the upper slope. In February worse weather resulted in fewer stations (five) and salinity data were obtained at only two of these. The vertical distribution of temperature is shown for both dates (Figure 9). Nearshore temperatures are lower in February than in November, as expected from the mid-shelf temperature time series (Figure 4a). Salinity and sigma-t distributions are shown only for November; isohalines and isopycnals both slope downwards toward the coast.

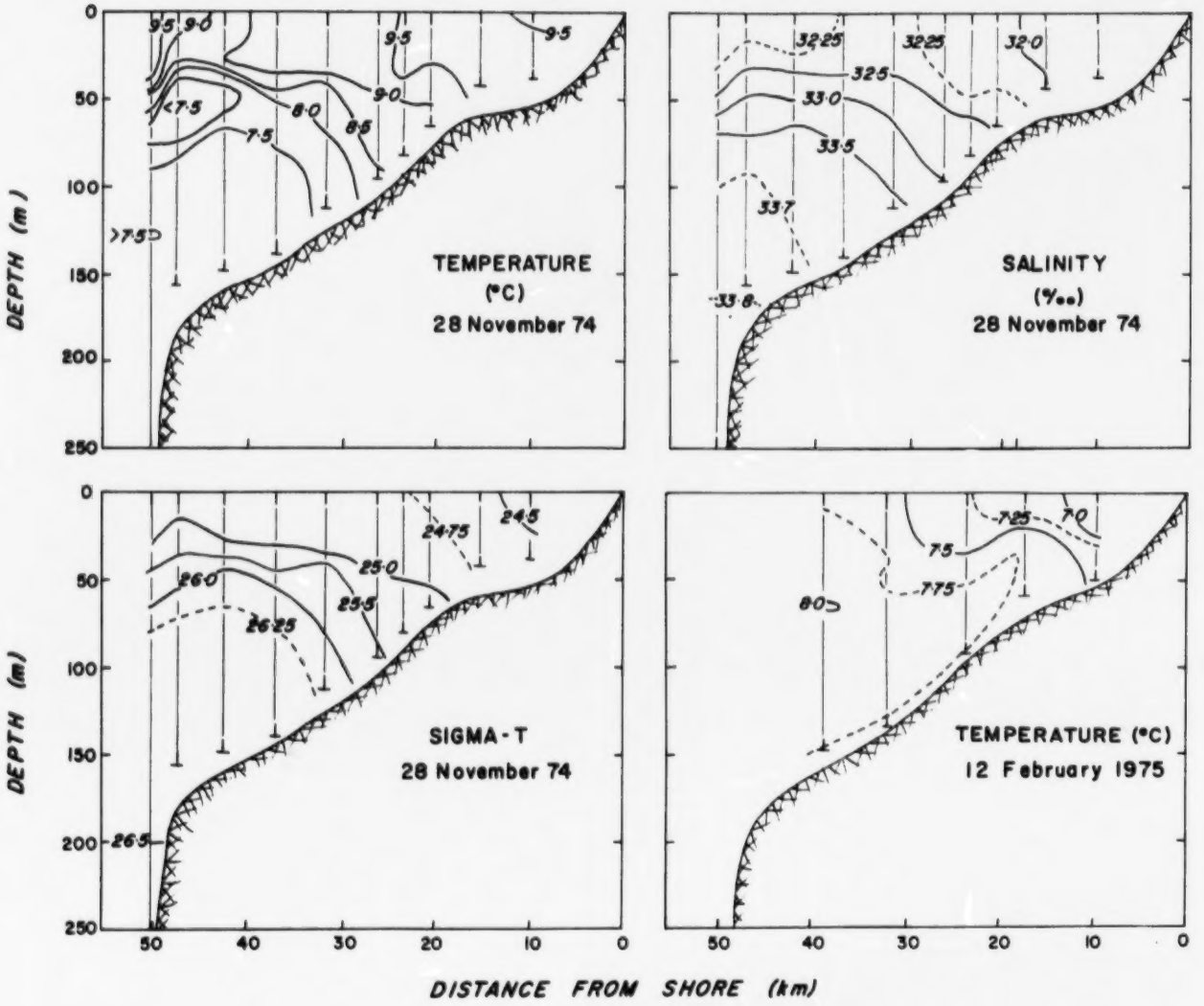

Figure 9

Vertical distributions of temperature, salinity and sigma-t along a line adjacent to the current meter array. Thin vertical lines ending in inverted T's show location and extent of STD casts.

C) WIND, ATMOSPHERIC PRESSURE, SEA LEVEL AND WAVES

Wind and atmospheric pressure are measured hourly at Tofino airport (49°05'N, 125°46'W); the data were obtained from the Atmospheric Environment Service. Wind data are reported by AES as wind speed (mph) and direction (° T) **from** which the wind blows; we calculated the eastward and northward components. Statistics of the hourly observations are given in Table III, and the time series are shown in Figure 10. The wind is highly variable, and the components have standard deviations much greater than their means. During the winter (December to February) most variability seems to have periods of several days; in late March and early April the wind shows diurnal fluctuations, probably due to the sea-breeze effect. The mean wind for the period from 28 November 1974 to 8 April 1975 is toward 250° T. The frequent reversals and general westward and south westward trends are apparent in the progressive vector diagram (Figure 11).

The atmospheric pressure data show fluctuations with periods of several days and longer (Figure 10). There is little apparent correlation with the wind.

Hourly sea level at Tofino (49°09.3'N, 125°54.5'W) was provided by the Tides and Water Levels Section of the Marine Environmental Data Service. Tidal fluctuations in sea level were suppressed by filtering the hourly data with a symmetrical Cosine-Lanczos filter with 121 weights. The filter has a power response of 0.94, 0.5 and 0.05 at 0.42, 0.71 and 0.82 cpd, respectively; the filter response is below 0.01 for frequencies greater than 0.9 cpd and between 1.0 and 1.02 for the frequency range 0.0 to 0.34 cpd. The resulting time series and its statistics are shown with the wind and atmospheric pressure (Figure 10 and Table III). The low passed sea level appears to be well correlated with the atmospheric pressure. (High atmospheric pressure is associated with low sea level).

Wave heights and periods are measured off Tofino (48°59.5'N, 125°45.1'W) with a Waverider Accelerometer Buoy as part of the Wave Climate Study conducted by the Marine Environmental Data Service. Wave data are recorded continuously for 20 minutes at 3 hour intervals. The data are processed at MEDS to yield a variety of data products, including the equivalent wave height by wave period. The characteristic wave height (the average height of the highest one third of the waves, regardless of period) and the peak (the period at which the spectral density is m . :mum) are shown in Figure 12 for December 1974 to March 1975. The peak period often exceeds 12 seconds; in deep water, a wave of this period has a wavelength exceeding 400 m. When large characteristic wave heights occur in conjunction with long peak periods, as on January 7, wave action may cause significant motion of the current meter arrays. Characteristic wave height appears to be correlated with local wind speed, this is evident from the wind and wave data for December and March (Figures 10 and 12). This implies waves were very high during the storm of 2 - 3 January (no wave data available) and probably significant mooring motion contributed to the speed, pressure, and temperature recording errors in the current meter record at 20 m OS.

Table III. Statistics of wind, atmospheric pressure and low passed sea level data from Tofino.

	Wind Components (m/sec)		Atmospheric	Low Passed
	Eastward	Northward	Pressure (mb)	Sea Level (cm)
Time, Date of First Data Point	0800 UT 28 November 1974		0800 UT 28 November 1974	2100 UT 30 November 1974
Time, Date of Last Data Point	0700 UT 8 April 1975		0700 UT 8 April 1975	1500 UT 5 April 1975
Data Interval (HR)	1	1	1	3
Number of Data Points	3144	3144	3144	1007
Minimum	-13.5	- 8.0	975.1	-40.4
Maximum	15.5	11.2	1033.7	55.9
Mean	- 0.5	- 0.2	1011.2	30.0
Std. Dev.	3.0	2.1	10.1	17.5

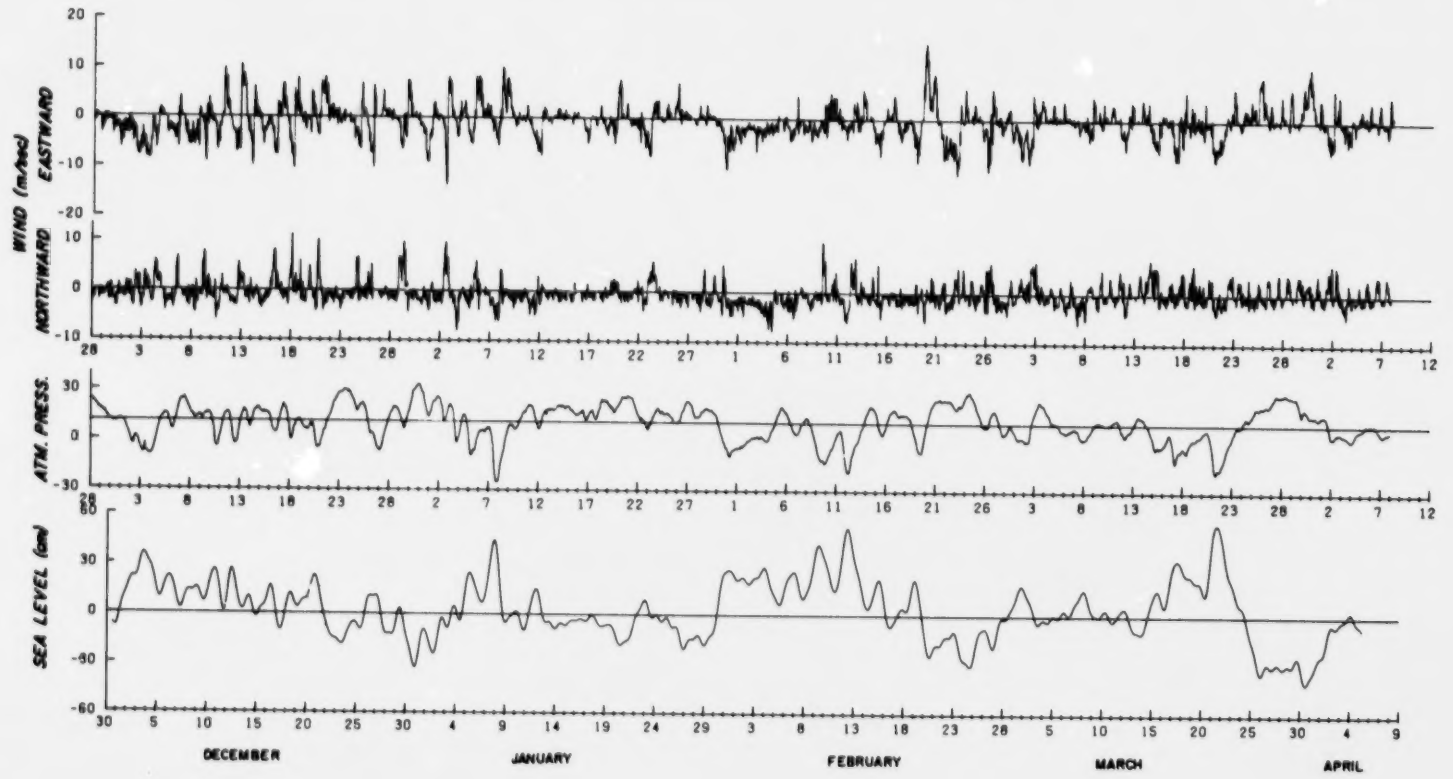

Figure 10

Time series of hourly wind and atmospheric pressure data, and of three-hourly values of the low passed sea level at Tofino. Atmospheric pressure is given as the deviation in millibars from 1000 mb.

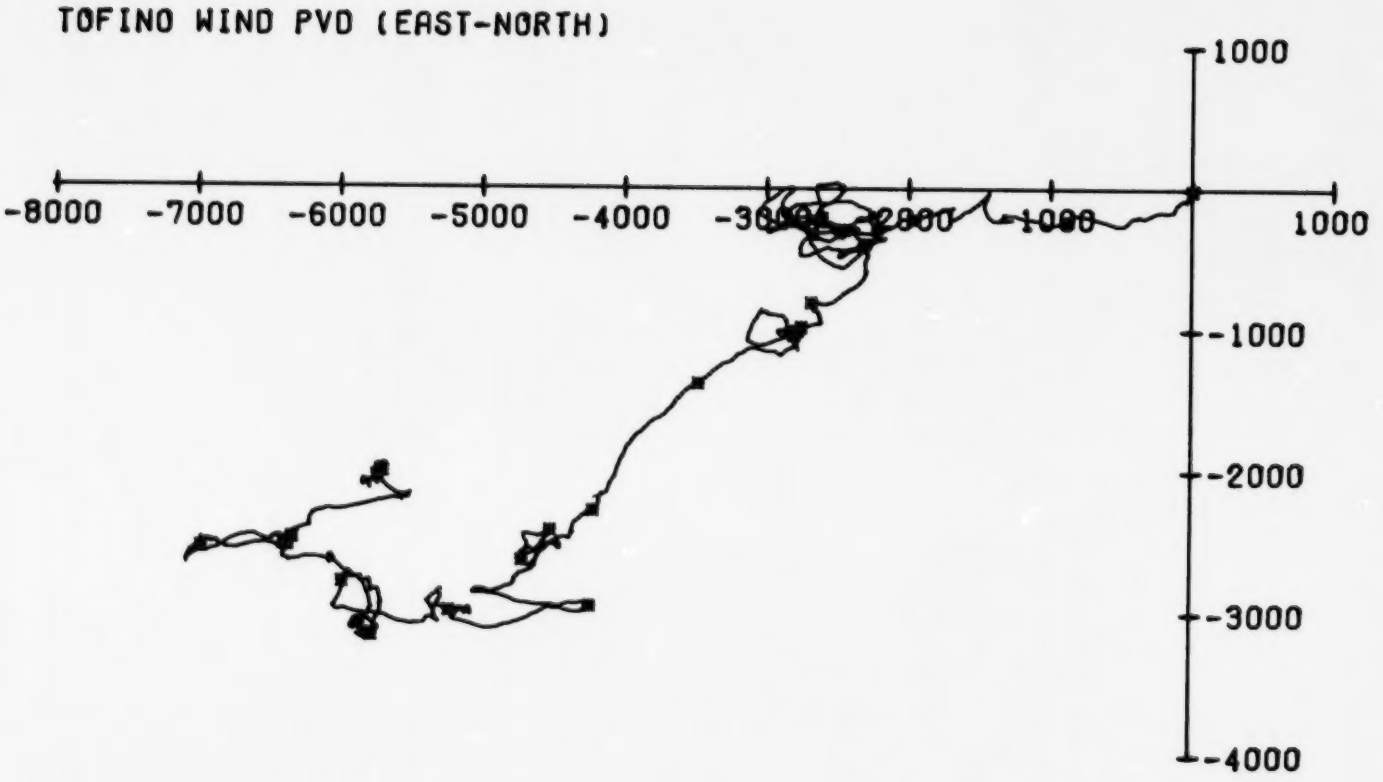

Figure 11
Progressive vector diagram of hourly wind observations, 28 November 1974 to 8 April 1975. Distances in km. Stars occur at 0800 UT, every fifth day.

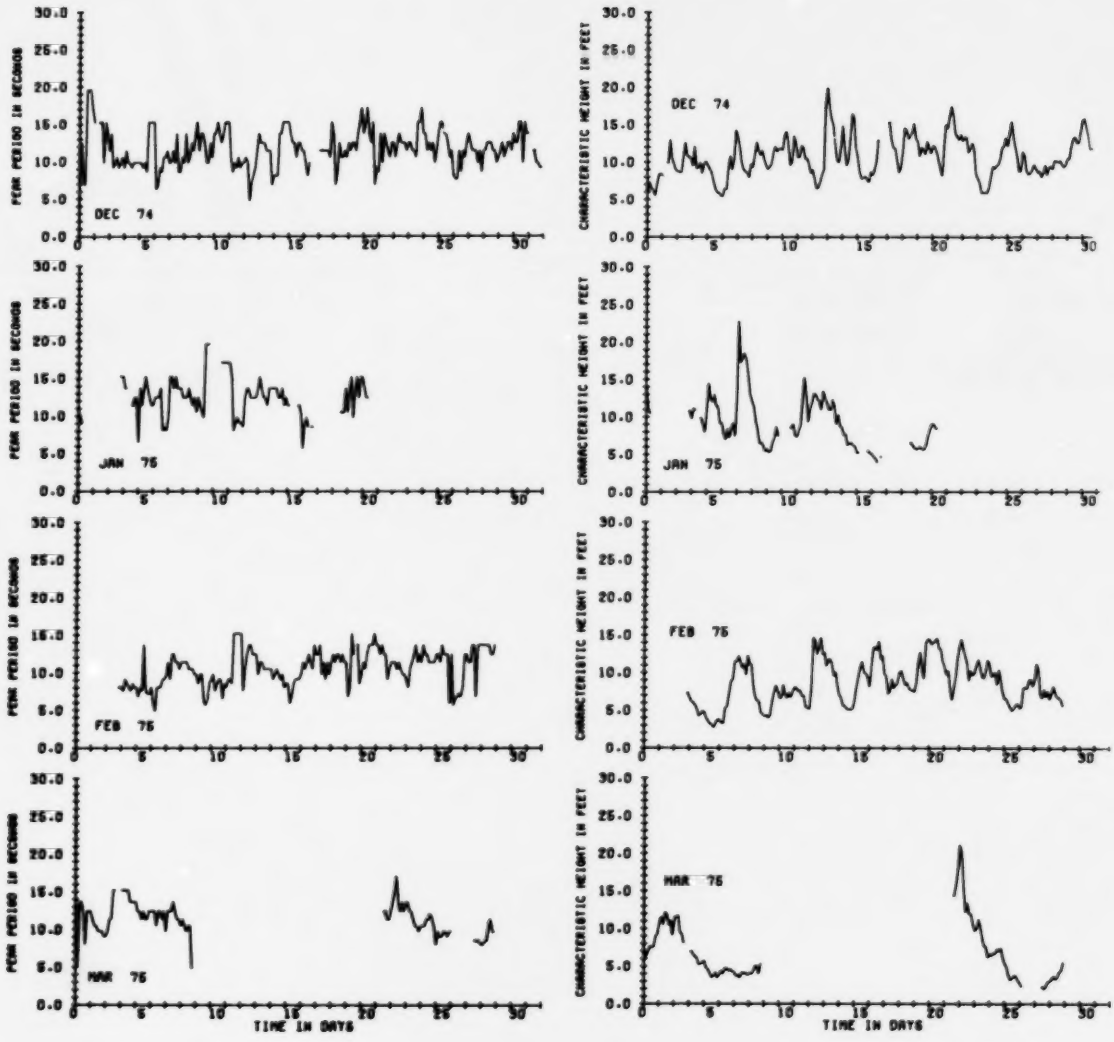

Figure 12

Time series of characteristic wave height and peak period of the waves measured by the Waverider buoy at 48°59.5'N, 125°45'W.

LOW PASSED CURRENT, SEA LEVEL AND WIND

The current data were low passed with the same Cosine Lanczos filter used for the sea level data. Use of the filter results in truncating the hourly data series by 2 1/2 days at each end. To avoid a six day gap when the current meter array was serviced in February, we joined records from the same location and approximately the same depth by inserting data in the one-day gap. To do this we simply used actual data from the neighbouring array (MS was replaced before OS was serviced). The half-hourly current data was decimated to hourly values before the filter was applied. The resulting time series of the low passed currents are shown in Figure 13. At the outer shelf mooring, persistent onshore flow near the surface was associated with offshore flow at the bottom (8 to 11 and 22 to 28 December, 20 to 31 January, 17 to 20 February, 24 to 30 March and 1 to 4 April). At the mid-shelf mooring, the onshore component was less persistent. Sometimes when the flow was onshore near the surface it was offshore near the bottom (e.g. 3 to 4 March); at other times (23 to 26 March) it was onshore at both the surface and the bottom, and offshore at mid-depth.

The alongshore flow was usually stronger and more variable over the mid-shelf than at the outer shelf. During winter, the flow was almost always poleward at the shallow current meters. As spring approached, the flow was more frequently equatorward, and the strength of equatorward currents increased. Over the mid-shelf, the alongshore flow usually decreased with depth, and an undercurrent (opposed to the surface current) was usually not observed.

The low passed sea level at Tofino showed a great deal of similarity to the inverted atmospheric pressure (Figure 10). We allowed for the "inverted barometer effect" by adjusting the sea level 1 cm for every 1 mb change in pressure (adding the low passed sea level and the low passed atmospheric pressure) and obtained the "adjusted sea level" shown in Figure 14. The low passed sea level fluctuations are very coherent with the near surface low passed current fluctuations over mid-shelf (Figure 13). Such similarity between current and sea level fluctuations has been observed before off Oregon and Washington in the summer (Cutchin and Smith 1973, Smith 1974, Huyer et al. 1975).

Eastward and northward components of the wind were also low passed (Figure 14). Neither low passed current nor sea level time series are particularly similar to the low passed wind series, though strong eastward winds are associated with low sea level. Rotation of the wind into an alongshore coordinate system does not seem to improve the correlation between wind and current data. The wind was generally offshore, and slightly equatorward (see Figure 11) while currents were strongly alongshore, and poleward most of the winter.

The lack of coherence between wind and sea level or current fluctuations surprised us, since the earlier observations off Oregon and Washington showed mutual high coherence between wind, sea level and currents (Huyer and Pattullo 1972, Smith 1974, Huyer et al. 1975). Current observations off Oregon during late winter and spring 1975 again showed high mutual coherence between wind, sea level, and currents over the mid-shelf (R.L. Smith, personal communication). It remains to be seen whether the lack of coherence between wind and sea level at Tofino is because the wind observations at Tofino airport are not representative of the wind field over the water, or whether the current and sea level fluctuations originate elsewhere and hence are not coherent with the local wind.

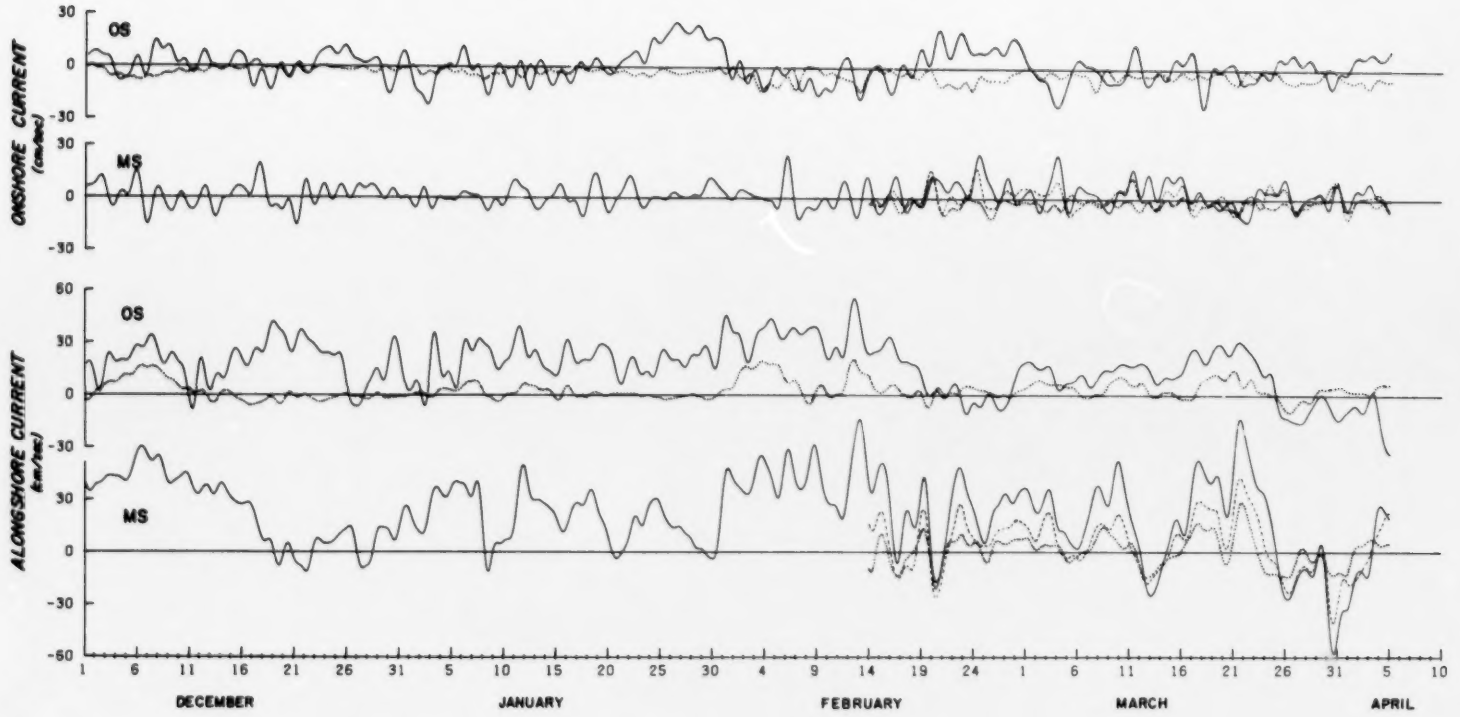

Figure 13

Time series of low passed components of the current. Solid lines are for the shallowest current meter at each location, dashed lines are for the current meter at mid-depth, and the dotted lines are for the deepest current meters.

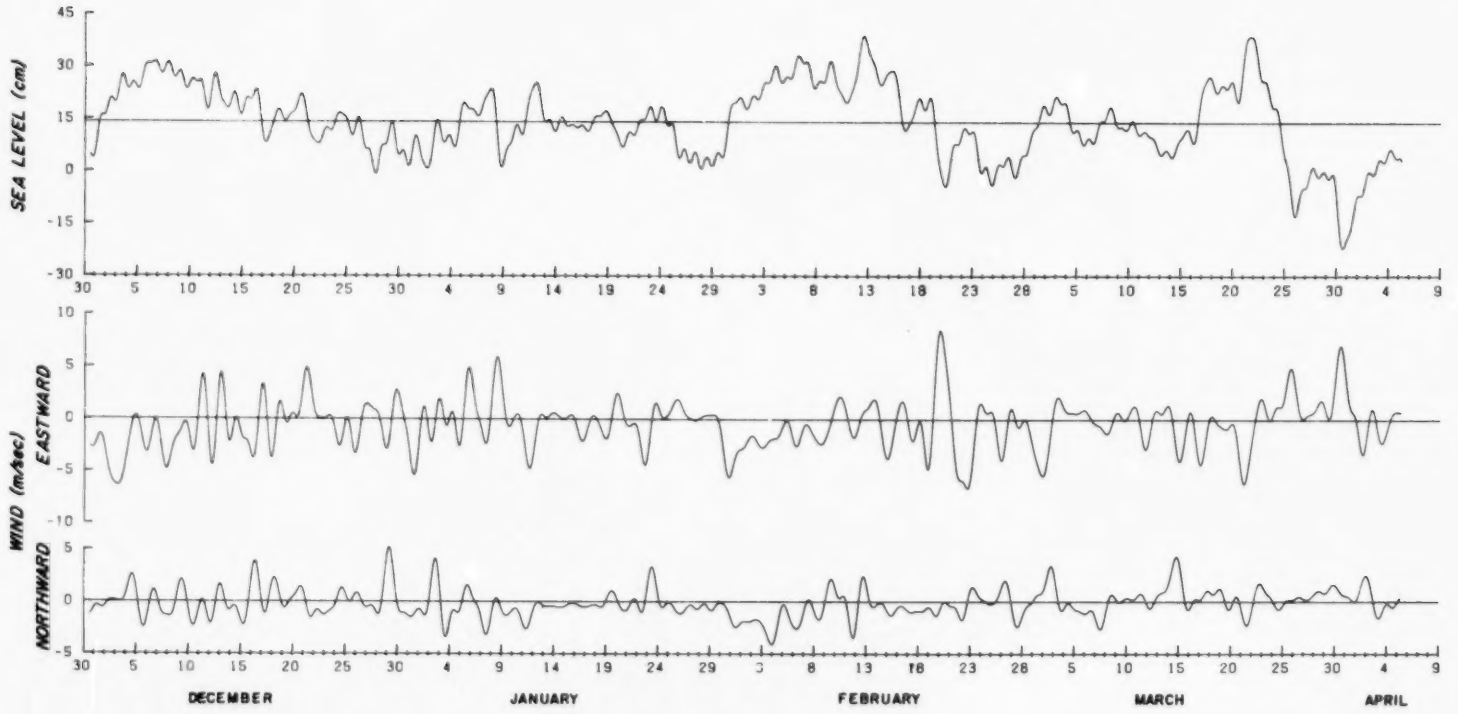

Figure 14

Time series of low passed adjusted sea level and wind at Tofino. Sea level has been adjusted for the inverted barometer effect.

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Huyer, A., B.M. Hickey, J.D. Smith, R.L. Smith and R.D. Pillsbury. 1975. Along-shore coherence at low frequencies in currents observed over the continental shelf off Oregon and Washington. J. Geophys. Res. 80(24):3495-3505.

Huyer, A. and J.G. Pattullo. 1972. A comparison between wind and current observations over the continental shelf off Oregon, summer 1969. J. Geophys. Res. 77(18):3215-3220.

Smith, R.L. 1974. A description of current, wind and sea level variations during coastal upwelling off Oregon coast, July-August 1972. J. Geophys. Res. 79(3):435-443.

ACKNOWLEDGEMENTS

Mr. Fred Hermiston assisted in preparing and servicing the current meters, and Mr. C. de Jong provided the STD traces. Officers and crew of *CSS Parizeau* did all the mooring work. Mr. Al Douglas did the preliminary current data processing, Dr. J.R. Wilson and Mr. Don Birrell processed the wave climate data. Mrs. Janet Davidson, Mrs. Cathy Pinard and Mrs. Gwladys Mowbray prepared the report for publication.

APPENDIX:

Current Histograms
and
Tidal Constituents

CURRENT HISTOGRAMS

On the following pages are histograms by speed and direction intervals. Speed is in hundredth of a knot, and direction is in degrees true. The direction histogram is given at the right hand edge of each table, and the speed histogram is at the bottom.

STN 001 and STN 002 correspond to the MS and OS moorings respectively, and the DEPTH is the best estimate of the current meter depth. A line at the bottom gives the mean total energy for the current record.

STN 001 DEPTH 015 START OF RECORD 00 MN 12 HR 28 DY 11 MO 74 YR LENGTH OF RECORD= 75 DAYS
RATE OF OBSER.= 2 PER HOUR

FREQUENCY DISTRIBUTION OF DIRECTION AND RATE KNOTS * .01

DIR	000 TO 009	010 TO 019	020 TO 029	030 TO 039	040 TO 049	050 TO 059	060 TO 069	070 TO 079	080 TO 089	090 TO 099	100 TO 109	110 TO 119	120 TO 129	130 TO 139	140 TO 149	150 TO 159	160 TO 169	170 TO 179	180 TO 189	190 TO 199	200 TO 209	210 TO 219	220 TO 229	230 TO 239	240 TO 249	
0- 9			001	006	020	024	031	009	004				001													96
10- 19			003	005	024	021	018	005	001	001																78
20- 29			004	005	011	012	009	003																		44
30- 39			005	005	009	007	003		001																	30
40- 49			004	005	009	007	004	001																		30
50- 59			005	011	020	007	005	001																		49
60- 69			002	010	014	009	005																			40
70- 79				009	014	009	004	002																		38
80- 89				009	011	007	008	004																		39
90- 99			001	013	019	009	007	003																		52
100-109				014	014	013	004	004																		49
110-119			001	007	015	008	004	001	001																	37
120-129				005	012	007	004	002																		30
130-139				012	013	007	007	006	001																	46
140-149				007	013	007	005	003	001																	36
150-159				011	010	005	005	002																		33
160-169				004	005	006	004	006	003																	28
170-179		001	001	002	013	008	001	003	001																	30
180-189				006	008	008	003	004	001																	30
190-199			001	006	007	011	007	002																		34
200-209		001		003	012	006	001																			23
210-219				008	008	010	004		002																	32
220-229			002	004	008	002		001																		17
230-239			001	003	007	012	001		002																	26
240-249				004	004	009	005	002																		24
250-259			003	007	016	017	006	006	001																	56
260-269			002	002	013	021	008	006	001																	53
270-279			002	004	012	009	006	006		003																42
280-289			002	004	021	035	022	013	010	008	003	001		001												120
290-299			002	006	030	037	022	031	010	018	009	002	001	002	002		001									173
300-309				008	025	061	046	057	054	029	033	015	013	006	003	003	001									354
310-319			001	009	037	054	055	062	056	040	043	023	017	007	002	005	001									412
320-329			001	008	040	052	057	072	081	077	041	034	023	012	005	006	001	002								512
330-339			001	004	033	057	065	072	054	041	030	025	028	012	003	005	003	003								436
340-349				007	022	039	057	036	038	016	006	013	011	010		002										257
350-359		001	002	007	017	034	028	030	010	006	007	005	011	011	003											172
	3		240		647		455		239		118		61		21		5		0		0		0			3558
	0	47		566		521		333		172		105		18		7		0		0		0		0		

Mean Total Energy is 0.5592 knots squared

STN 001 DEPTH 029 START OF RECORD 00 MN 11 HR 11 DY 02 MO 75 YR LENGTH OF RECORD= 56 DAYS
RATE OF OBSER.= 2 PER HOUR

FREQUENCY DISTRIBUTION OF DIRECTION AND RATE KNOTS * .01

DIR	000 TO 009	001 TO 019	010 TO 029	020 TO 039	030 TO 049	040 TO 059	050 TO 069	060 TO 079	070 TO 089	080 TO 099	090 TO 109	100 TO 119	110 TO 129	120 TO 139	130 TO 149	140 TO 159	150 TO 169	160 TO 179	170 TO 189	180 TO 199	190 TO 209	200 TO 219	210 TO 229	220 TO 239	230 TO 249	240 TO	
0- 9		002	012	014	018	004	008	002	001																		61
10- 19		004	014	027	025	009	004	001																			84
20- 29		004	018	022	010	010	006	001																			71
30- 39		001	007	015	011	004	001																				39
40- 49		004	019	015	011	006	001																				56
50- 59		009	006	010	011	006	003																				45
60- 69		004	010	012	012	005		001																			44
70- 79		002	014	014	009	001		001																			41
80- 89		004	009	009	008	002	001																				33
90- 99		004	009	019	004	003	001																				40
100-109		004	009	014	013	002	001	006	001																		50
110-119		003	008	017	010	010	003	005		001	001	001															59
120-129		002	009	018	006	007	006	003	004	002	002																59
130-139		001	010	011	008	009	004	008	002		001																54
140-149		001	014	010	015	009	007	005	003	002	003																69
150-159		003	019	015	007	005	002	003	004																		58
160-169		001	023	015	006	001	004		002																		52
170-179		004	012	010	004	002	003	002	002																		39
180-189		005	011	003	002	003	002		001																		27
190-199		003	007	010	003	004																					27
200-209			004	003	004																						11
210-219		002	008	006	002																						18
220-229		002	003	006	001																						12
230-239			005	007	001																						13
240-249		002	004	001	002																						9
250-259		003	005	006	005	001																					20
260-269		006	013	006	004	002																					31
270-279			016	018	013	006		001																			54
280-289		002	013	022	012	016	006	001	002	001		001															76
290-299		005	010	032	031	021	015	007	008	004	002	001															136
300-309		001	012	033	036	033	029	016	013	005	007	005		002													192
310-319		004	018	032	035	049	041	018	017	018	013	006	001														252
320-329		004	016	034	045	027	031	019	036	013	010	003	002														240
330-339		004	019	039	054	045	026	019	018	014	011	005	001														255
340-349		006	014	033	040	029	021	008	007	007	007																172
350-359	001	002	016	040	035	029	015	012	004																		154
		108		598		360		139		67		22		2		0		0		0		0		0		0	2653
	1		416		513		241		125		57		4		0		0		0		0		0		0		

Mean Total Energy is 0.2754 knots squared

STN 001 DEPTH 053 START OF RECORD 00 MN 11 HR 11 DY 02 MO 75 YR LENGTH OF RECORD= 56 DAYS
RATE OF OBSER.= 2 PER HOUR

FREQUENCY DISTRIBUTION OF DIRECTION AND RATE KNOTS * .01

DIR	000 TO 009	010 TO 019	020 TO 029	030 TO 039	040 TO 049	050 TO 059	060 TO 069	070 TO 079	080 TO 089	090 TO 099	100 TO 109	110 TO 119	120 TO 129	130 TO 139	140 TO 149	150 TO 159	160 TO 169	170 TO 179	180 TO 189	190 TO 199	200 TO 209	210 TO 219	220 TO 229	230 TO 239	240 TO 249	
0- 9		007	025	029	007	004	001	001																		74
10- 19	001	005	015	021	006		001																			49
20- 29		006	024	017	005	002																				54
30- 39		001	005	007			001																			14
40- 49		004	020	008	001	003																				36
50- 59		006	021	008																						35
60- 69		003	016	011		003	004																			37
70- 79		006	017	010	005	003																				41
80- 89		004	013	011	002	001	001																			32
90- 99		001	010	006	004		001			001		001														24
100-109		006	023	009	004		001	002	001		001	002														49
110-119		006	021	014	017	001		001		003	001															64
120-129		008	017	018	017	004	002	003	005	006																80
130-139	001	007	017	026	018	007	007	002	005	002																92
140-149		003	025	026	015	011	006	002	002	001	001															92
150-159		010	019	035	012	011	012	002	001		004															106
160-169	002	004	021	025	008	004	009																			73
170-179		009	024	020	015	008	001	001																		78
180-189		004	022	019	009	004	001																			59
190-199		007	014	011	005	001																				38
200-209	001	010	013	008	002	002																				36
210-219		008	010	011	001																					30
220-229		010	010	006	001																					27
230-239	001	007	011	005																						24
240-249		005	016	005																						26
250-259		010	017	001																						28
260-269		008	017	005	001		001	001																		33
270-279		010	023	013	005	002	001	001																		55
280-289		007	027	010	013	013	007	003		001																81
290-299		010	033	029	025	021	007	006	004	002																137
300-309	001	011	031	035	026	023	009	003	005	006	001	002	001	001												155
310-319		013	033	032	031	020	020	014	009	002	005	005	005													189
320-329		007	041	050	032	040	019	010	008	009	007	001	002	001	002											229
330-339		009	037	053	052	043	028	013	008	003	002	001														249
340-349	001	006	016	040	022	018	008	003	002	002	002	001														121
350-359		012	022	032	019	009	003	003	002	001	001	002														106
		250		666		258		71		39		15		2		0		0		0		0		0		2653
	8		726		380		151		52		25		8		2		0		0		0		0		0	

Mean total Energy is 0.1949 knots squared

STN 001 DEPTH 091 START OF RECORD 00 MN 11 HR 11 DY 02 MO 75 YR LENGTH OF RECORD= 56 DAYS
RATE OF OBSER.= 2 PER HOUR

FREQUENCY DISTRIBUTION OF DIRECTION AND RATE KNOTS * .01

DIR	000 TO 009	010 TO 019	020 TO 029	030 TO 039	040 TO 049	050 TO 059	060 TO 069	070 TO 079	080 TO 089	090 TO 099	100 TO 109	110 TO 119	120 TO 129	130 TO 139	140 TO 149	150 TO 159	160 TO 169	170 TO 179	180 TO 189	190 TO 199	200 TO 209	210 TO 219	220 TO 229	230 TO 239	240 TO 249	
0- 9		016	015	010	004																					45
10- 19	005	023	017	009	005	002																				61
20- 29	002	011	023	007		001																				44
30- 39	001	013	022	007																						43
40- 49		016	020	006	002																					44
50- 59	001	007	019	009	004																					40
60- 69	005	011	016	009	001																					42
70- 79		017	022	018	003	001																				61
80- 89	002	017	035	022	008	005	001																			90
90- 99		013	019	020	011	005	003																			71
100-109	001	011	016	016	003	009	001																			57
110-119		011	019	013	007	004	003																			57
120-129	001	015	017	023	013	004																				73
130-139		021	033	020	011																					85
140-149	003	014	026	019	015																					77
150-159	003	011	030	029	009																					82
160-169	001	024	021	018	010	001																				75
170-179	001	020	025	015	005	002																				68
180-189		018	025	021	004	001																				69
190-199	003	012	029	014	003	001																				62
200-209	004	015	028	015	006	001																				69
210-219	001	025	014	013	011	001																				65
220-229	001	020	020	013	003	002																				59
230-239	002	012	021	015	001																					51
240-249		010	023	017	007	002	002	001																		62
250-259	002	018	046	040	008	002		001																		117
260-269	002	018	040	030	017	002	001																			110
270-279		016	043	044	011	010																				124
280-289	003	014	050	031	016	004	001																			119
290-299	001	011	034	035	019	004	003	003	001																	111
300-309	002	021	033	044	017	008	001	003	001																	130
310-319	003	014	025	026	013	004	006	004	002																	97
320-329	001	018	032	024	018	007	004	001	001	001																107
330-339		015	017	016	007	004																				59
340-349	002	028	015	010	007	005		001																		68
350-359		026	016	009	007	001																				59
		582		687		93		14		1		0		0		0		0		0		0		0		2653
	53		906		286		26		5		0		0		0		0		0		0		0		0	

Mean Total Energy is 0.0957 knots squared

STN 002 DEPTH 009 START OF RECORD 00 MN 19 HR 29 DY 11 MO 74 YR LENGTH OF RECORD= 31 DAYS
RATE OF OBSER.= 2 PER HOUR

FREQUENCY DISTRIBUTION OF DIRECTION AND RATE KNOTS * .01

DIR	000 TO 009	010 TO 019	020 TO 029	030 TO 039	040 TO 049	050 TO 059	060 TO 069	070 TO 079	080 TO 089	090 TO 099	100 TO 109	110 TO 119	120 TO 129	130 TO 139	140 TO 149	150 TO 159	160 TO 169	170 TO 179	180 TO 189	190 TO 199	200 TO 209	210 TO 219	220 TO 229	230 TO 239	240 TO 249	
0- 9				002	003	025	021	020	014	014	004	001														104
10- 19				001	015	019	018	012	011	004		001														81
20- 29			001	001	013	026	027	009	015	003																95
30- 39				004	009	009	006	006	002																	36
40- 49				002	003	011	012	009	007																	44
50- 59				002	007	009	005	007		001																31
60- 69					009	008	005	002	002	001																27
70- 79				001	005	006	004	006	001																	23
80- 89				004	006	001	002	001																		14
90- 99					010	006	001	004	001	001																23
100-109				001	004	007	002																			14
110-119					004	001	001	004																		10
120-129				002	002	001	002	001		002	001															11
130-139					001	001	001	004	001																	8
140-149					004	003	005	001																		13
150-159					005	005		003																		13
160-169				001	006	006	001	001																		15
170-179					002	001	003	003																		9
180-189				002	002	002	002																			8
190-199					006	004	004	002																		16
200-209				002	003	004	004	003																		16
210-219				002	007	010	003	001																		23
220-229				001	001	006	001	001																		10
230-239					003	009		003		001																16
240-249					003	003	002	001	002																	11
250-259				001	006	004	003	001																		15
260-269				001	006	006	006	003	003	002																27
270-279				002	013	013	010	002	004	005		001														50
280-289			001	002	005	012	008	009	007	002	002															48
290-299				001	003	013	011	013	007	003	002	001														54
300-309				002	006	021	017	018	018	006	002	002	002	001												95
310-319				001	008	022	012	015	012	008	006	005	004													93
320-329				002	010	020	016	015	014	005	005	001	003													91
330-339				006	011	032	025	034	014	007	001	001	001													132
340-349			001		005	017	013	016	017	002	003	002														76
350-359				002	005	011	015	027	015	015	006	001														97
	0		48		354		257		82		16		1		0		0		0		0		0			1449
	0	3		211		268		167		32		10		0		0		0		0		0		0		

Mean Total Energy is 0.4647 knots squared

STN 002 DEPTH 009 START OF RECORD 30 MN 10 HR 07 DY 01 MO 75 YR LENGTH OF RECORD= 36 DAYS
RATE OF OBSER.= 2 PER HOUR

FREQUENCY DISTRIBUTION OF DIRECTION AND RATE KNOTS * .01

DIR	000 TO 009	010 TO 019	020 TO 029	030 TO 039	040 TO 049	050 TO 059	060 TO 069	070 TO 079	080 TO 089	090 TO 099	100 TO 109	110 TO 119	120 TO 129	130 TO 139	140 TO 149	150 TO 159	160 TO 169	170 TO 179	180 TO 189	190 TO 199	200 TO 209	210 TO 219	220 TO 229	230 TO 239	240 TO 249	
0- 9			001	012	016	020	035	023	010	004	004	002	001	001			001									130
10- 19			001	008	017	024	012	026	012	005	001	001	002	001		001										111
20- 29				009	013	030	015	021	012	003	001	001		001	001											107
30- 39				003	006	009	008	009	005	001	001															42
40- 49				001	009	012	010	008	003	001	001															45
50- 59				003	003	013	007	006	001																	33
60- 69			002	002	002	008	006	005	001	001																27
70- 79		001	001	005	004	001	007	001	001																	21
80- 89				004	003	003	002	003																		15
90- 99				001	002	003																				6
100-109				001		001																				2
110-119				001	001	001	001																			4
120-129			002	005																						7
130-139				001		001	001																			3
140-149			001	001		002																				4
150-159			002	001		001																				4
160-169			001	002		001	001																			5
170-179				001	002																					3
180-189			003	001	001																					5
190-199			003	001																						4
200-209				002	001	001	001																			5
210-219					003	001																				4
220-229			001		002		001																			4
230-239					005	003	002																			10
240-249		001		001			004	001	001																	8
250-259			001	002	002	005	003	003	002																	18
260-269			001	005	004	009	006	003	002		001															31
270-279			002	005	009	007	008	001	007	005																44
280-289			002	001	008	011	008	005	007	001	003	001														47
290-299			002	007	013	012	007	015	009	007	003	002	001	001												79
300-309				006	017	026	021	014	015	015	007	005	002													128
310-319				005	019	029	023	010	017	015	008	006	005	002	001											140
320-329				008	013	023	031	021	027	013	007	005	002	001												151
330-339			001	004	027	030	024	019	014	015	013	006		002												155
340-349			001	004	020	023	032	029	020	007	007	003	001													147
350-359			001	006	013	021	025	028	019	010	007	001	001	002	003											137
	2		119		331		251		103		33		11			1		0		0		0		0		1686
	0		29		235		301		105		64		15		5		1		0		0		0		0	

Mean Total Energy is 0.4862 knots squared

STN 002 DEPTH 015 START OF RECORD 00 MN 15 HR 12 DY 02 MO 75 YR LENGTH OF RECORD= 55 DAYS
RATE OF OBSER.= 2 PER HOUR

FREQUENCY DISTRIBUTION OF DIRECTION AND RATE KNOTS * .01

DIR	000 TO 009	010 TO 019	020 TO 029	030 TO 039	040 TO 049	050 TO 059	060 TO 069	070 TO 079	080 TO 089	090 TO 099	100 TO 109	110 TO 119	120 TO 129	130 TO 139	140 TO 149	150 TO 159	160 TO 169	170 TO 179	180 TO 189	190 TO 199	200 TO 209	210 TO 219	220 TO 229	230 TO 239	240 TO 249	
0- 9		001	013	025	023	014	009	015	002		001															105
10- 19		002	018	021	016	024	017	003	003	001																121
20- 29		006	017	025	026	029	012	005	001																	56
30- 39		003	005	018	018	009	005																			71
40- 49			016	011	022	014	006	002																		59
50- 59		001	011	022	015	007	003																			69
60- 69		001	017	015	016	014	006																			72
70- 79		001	019	017	022	011	002																			58
80- 89		004	007	010	015	013	001																			68
90- 99		005	013	021	010	014	005																			57
100-109			010	009	022	010	005		001																	62
110-119		003	006	020	017	007	005	003		001																63
120-129		001	006	006	020	018	007	001	003	001																66
130-139		001	009	014	014	013	009	001	002	002	001															74
140-149		002	008	010	018	015	009	002	004	003	003															60
150-159		001	006	007	014	011	013	005			003															62
160-169		001	013	010	009	013	010	002	002	001	001															44
170-179			009	010	009	008	004	003		001																29
180-189			003	003	012	006	003	001		001																36
190-199			005	008	015	002	002	003		001																23
200-209	002			007	008	003	002	001																		19
210-219			001	008	006	002		001	001																	29
220-229		004	006	004	008	003	001	001	001	001																24
230-239			007	004	009	003			001																	29
240-249		001	007	008	010	001	002																			42
250-259		001	004	010	016	006	003	001			001															38
260-269			002	007	013	008	002	003	001		002															76
270-279			005	012	026	016	012	001	001		002	001														74
280-289		002	003	016	015	021	010	001	002	003		001														86
290-299			011	015	021	015	010	003	003	003	002		002						001							127
300-309		001	006	023	025	032	015	005	005	008	004		001	002												121
310-319		001	008	026	023	027	019	008		004	002			001		001		001								149
320-329		001	010	030	035	035	014	006	004	005	002	001	002	002		001	001									170
330-339		001	018	025	043	030	023	018	005	003	003						001									136
340-349		001	017	031	028	031	015	007	004		001				001											127
350-359		001	014	034	024	023	021	009			001															2599
	0	49	330	542	643	508	282	111	46	39	29	3	5	5	1	2	3	1	0	0	0	0	0	0	0	

Mean Total Energy is 0.02603 knots squared

STN 002 DEPTH 175 START OF RECORD 30 MN 14 HR 28 DY 11 MO 74 YR LENGTH OF RECORD= 75 DAYS
RATE OF OBSER.= 2 PER HOUR

FREQUENCY DISTRIBUTION OF DIRECTION AND RATE KNOTS * .01

DIR	000 TO 003	010 TO 019	020 TO 029	030 TO 039	040 TO 049	050 TO 059	060 TO 069	070 TO 079	080 TO 089	090 TO 099	100 TO 109	110 TO 119	120 TO 129	130 TO 139	140 TO 149	150 TO 159	160 TO 169	170 TO 179	180 TO 189	190 TO 199	200 TO 209	210 TO 219	220 TO 229	230 TO 239	240 TO 249	
0- 9	006	021	017	007	003																					58
10- 19	005	024	026	003																						51
20- 29	004	028	016	003																						21
30- 39	002	010	008	001																						37
40- 49	004	023	009	001																						46
50- 59	006	024	015		001																					40
60- 69	005	020	010	005																						58
70- 79	006	026	023	002	001																					71
80- 89	006	026	017	013	009																					91
90- 99	005	025	036	021	004																					106
100-109	003	037	040	022	004																					128
110-119	013	042	050	018	005																					118
120-129	008	047	050	010	003																					103
130-139	009	039	037	016	002																					80
140-149	006	041	025	008																						77
150-159	001 004	043	027	003																						67
160-169	001 007	033	025	002																						65
170-179	012	036	017																							72
180-189	013	043	016																							83
190-199	007	040	033	002	001																					83
200-209	018	029	032	004																						69
210-219	008	026	029	003	003																					118
220-229	007	040	045	021	005																					121
230-239	006	042	046	022	004	001																				133
240-249	003	047	042	034	006	001																				126
250-259	003	038	057	022	002	003	001																			131
260-269	007	041	049	026	007	001																				139
270-279	008	043	039	019	019	007	004																			156
280-289	001	024	052	047	019	007	005	001																		222
290-299	007	034	060	049	036	018	012	004	002																	196
300-309	006	038	048	049	034	012	005	003	001																	199
310-319	005	044	051	043	031	017	007		001																	182
320-329	004	049	050	039	025	011	004																			127
330-339	007	050	036	016	013	005																				83
340-349	006	029	022	023	009																					80
350-359	010	033	021	013	003																					3597
	1235		567		83		8		0		0		0		0		0		0		0		0		0	
	237		1176		249		38		4		0		0		0		0		0		0		0		0	

Mean Total Energy is 0.0720 knots squared

STN 002 DEPTH 200 START OF RECORD 00 MN 15 HR 12 DY 02 MO 75 YR LENGTH OF RECORD= 55 DAYS
RATE OF OBSER.= 2 PER HOUR

FREQUENCY DISTRIBUTION OF DIRECTION AND RATE KNOTS * .01

DIR	000 TO 009	010 TO 019	020 TO 029	030 TO 039	040 TO 049	050 TO 059	060 TO 069	070 TO 079	080 TO 089	090 TO 099	100 TO 109	110 TO 119	120 TO 129	130 TO 139	140 TO 149	150 TO 159	160 TO 169	170 TO 179	180 TO 189	190 TO 199	200 TO 209	210 TO 219	220 TO 229	230 TO 239	240 TO 249	
0- 9		019	034	018	003	001																				75
10- 19	001	017	055	025	004	002	001																			104
20- 29		024	036	011	008																					79
30- 39	001	016	021	010	001																					48
40- 49	001	013	029	009																						51
50- 59	001	018	026	004																						48
60- 69	003	009	016		001																					26
70- 79	001	011	015																							26
80- 89	001	013	014	002																						29
90- 99	001	013	008	002																						23
100-109		012	011																							23
110-119		006	015																							21
120-129		018	014	001																						33
130-139		012	015	002																						29
140-149		008	024	001																						33
150-159		017	035	008	001																					61
160-169		012	029	013	002																					56
170-179		013	023	014	006																					56
180-189		014	024	010																						48
190-199	002	017	021	009																						47
200-209		011	011	006	001																					29
210-219		012	020	006	003																					41
220-229		020	020	008	005	001																				54
230-239		016	025	013	015	008	002																			79
240-249	001	018	037	027	021	020	005	003																		131
250-259	001	018	025	027	028	018	010	015	006																	147
260-269	001	014	027	024	029	015	010	017	005																	141
270-279		014	027	024	023	011	017	010	003																	129
280-289	002	016	030	033	016	024	013	008	001	001		001	001	001												145
290-299	001	016	038	028	021	011	010	003	001																	128
300-309	001	019	038	031	015	014	005	004		001																127
310-319	002	012	045	026	018	012	002	003																		118
320-329	001	021	042	019	012	008	006	002																		110
330-339		025	043	023	010	003	004	002	002																	112
340-349	001	017	037	022	012	004		002																		94
350-359		008	034	014	014	005																				75
		964		269		85		18		0		1		0		0		0		0		0		0		2576
	539		470		157		69		2		1		1		0		0		0		0		0		0	

Mean Total Energy is 0.0693 knots squared

TIDAL CONSTITUENTS

The tidal constituents for each current record are shown on the following pages. The results are given in the form of tidal ellipses.

Each table shows the current meter mooring location and depth. For each constituent, the table lists its name, frequency in cycles per hour, the length of the major and minor axes (m/sec) of the current ellipse, the inclination of the major axis from east (in degrees, positive counterclockwise), and the phase angle.

The record from 9 m; OS, first installation, has been split into two sections, deleting the eight days with frequent speed spikes. Hence, there are two tables of tidal constituents for this record.

FINAL RESULTS IN CURRENT ELLIPSE FORM, WITH NODAL CORRECTIONS, SCALING UP FOR FILTER COMPENSATION

001015 013281174

	NAME	FREQUENCY	MAJOR	MINOR	INC.	G	G+	G-
1	Z0	0.0	0.471	0.0	125.1	-0.0	234.9	125.1
2	MM	0.00151215	0.260	0.022	130.6	67.8	297.2	198.4
3	MSF	0.00282193	0.038	0.026	146.6	174.3	27.7	320.9
4	2Q1	0.03570635	0.021	-0.011	27.7	298.3	270.6	326.0
5	Q1	0.03721850	0.037	-0.013	132.7	299.4	166.7	72.2
6	O1	0.03873065	0.113	-0.063	158.2	303.4	145.3	101.6
7	NO1	0.04026859	0.075	-0.017	131.5	239.9	108.5	11.4
8	K1	0.04178074	0.342	-0.120	139.0	336.0	197.1	115.0
9	J1	0.04329290	0.026	0.006	15.1	33.0	17.9	48.1
10	OO1	0.04483084	0.041	-0.009	150.6	350.6	200.0	141.2
11	MNS2	0.07617730	0.017	-0.012	84.0	220.7	136.8	304.7
12	MU2	0.07768947	0.020	-0.009	83.7	243.5	159.8	327.2
13	N2	0.07899922	0.030	-0.016	50.1	304.8	254.7	354.9
14	M2	0.08051139	0.139	-0.059	58.2	302.6	244.4	0.8
15	L2	0.08202350	0.024	-0.020	172.8	330.8	157.9	143.6
16	S2	0.08333331	0.031	-0.010	56.8	325.0	268.2	21.7
17	KJ2	0.08507359	0.025	-0.013	138.0	288.3	150.3	66.2
18	2SM2	0.08515524	0.022	-0.001	110.2	177.9	67.6	288.1
19	MO3	0.11924207	0.018	-0.012	49.1	124.0	75.0	173.1
20	M3	0.12076706	0.024	0.005	54.4	327.7	273.3	22.1
21	MK3	0.12229204	0.022	0.000	54.0	9.2	315.2	63.1
22	SK3	0.12511408	0.008	-0.007	11.5	304.5	293.0	316.0
23	MN4	0.15951055	0.007	-0.001	60.7	319.8	259.1	20.6
24	M4	0.16102278	0.005	-0.002	127.7	146.1	18.4	273.8
25	SN4	0.16233259	0.003	0.003	128.5	297.9	169.4	66.4
26	MS4	0.16384465	0.005	0.001	60.3	59.2	358.9	119.5
27	S4	0.16666669	0.009	-0.000	71.9	327.4	255.5	39.3
28	2MN6	0.24002194	0.006	-0.004	92.9	4.7	271.8	97.6
29	M6	0.24153417	0.005	-0.001	52.8	330.2	277.4	23.0
30	MSN6	0.24284399	0.007	-0.001	127.9	207.3	79.4	335.2
31	2MS6	0.24435610	0.007	0.004	90.0	41.2	311.2	131.2
32	2SM6	0.24717809	0.006	-0.002	57.0	210.5	153.5	267.6
33	3MN8	0.32053339	0.005	0.004	17.8	42.7	24.9	60.5
34	M8	0.32204556	0.005	0.002	83.2	265.6	182.4	348.8
35	3MS8	0.32486749	0.001	0.000	93.1	68.8	335.8	161.9
36	M12	0.48306835	0.010	-0.000	18.8	221.2	202.4	240.1

FINAL RESULTS IN CURRENT ELLIPSE FORM,WITH NODAL CORRECTIONS,SCALING UP FOR FILTER COMPENSATION

001029 01211 275

	NAME	FREQUENCY	MAJOR	MINOR	INC.	G	G+	G-
1	ZO	0.0	0.241	0.0	116.3	-0.0	243.7	116.3
2	MM	0.00151215	0.175	0.006	125.9	261.4	135.4	27.3
3	MSF	0.00282193	0.086	-0.020	141.5	212.7	71.2	354.1
4	2Q1	0.03570635	0.014	0.000	116.9	33.5	276.6	150.4
5	Q1	0.03721850	0.027	-0.008	151.9	281.2	129.3	73.0
6	O1	0.03873065	0.122	-0.053	138.4	315.7	177.3	94.0
7	NO1	0.04026859	0.024	0.007	145.4	346.5	201.1	131.9
8	K1	0.04178074	0.201	-0.067	145.8	340.2	194.5	126.0
9	J1	0.04329290	0.039	-0.022	52.9	110.2	57.3	163.1
10	001	0.04483084	0.010	0.004	79.7	353.2	273.5	72.9
11	MNS2	0.07617730	0.029	-0.021	39.2	321.2	282.0	0.4
12	MU2	0.07768947	0.009	-0.005	153.7	152.7	359.0	306.4
13	N2	0.07899922	0.031	-0.007	67.0	260.4	193.4	327.4
14	M2	0.08051139	0.092	0.005	72.4	293.2	220.8	5.5
15	L2	0.08202350	0.016	-0.010	55.0	297.6	242.7	352.6
16	S2	0.08333331	0.036	0.009	67.8	310.8	243.1	18.6
17	KJ2	0.08507359	0.015	-0.010	71.8	136.3	64.5	208.1
18	2SM2	0.08615524	0.023	-0.019	114.7	292.7	178.0	47.4
19	MO3	0.11924207	0.003	-0.001	92.3	345.4	253.1	77.7
20	M3	0.12076706	0.005	0.001	95.8	34.6	298.9	130.4
21	MK3	0.12229204	0.012	0.002	104.6	106.5	1.9	211.1
22	SK3	0.12511408	0.007	-0.002	62.3	281.2	218.9	343.5
23	MN4	0.15951055	0.005	0.001	125.8	62.1	296.3	188.0
24	M4	0.16102278	0.007	0.001	81.0	162.8	81.7	243.8
25	SN4	0.16233259	0.010	-0.003	166.4	93.5	287.1	259.9
26	MS4	0.16384465	0.010	-0.001	109.1	96.2	347.1	205.3
27	S4	0.16666669	0.016	-0.005	175.1	178.8	3.7	353.9
28	2MN6	0.24002194	0.005	-0.001	137.8	87.2	309.3	225.0
29	M6	0.24153417	0.006	0.001	91.0	126.2	35.1	217.2
30	MSN6	0.24284399	0.010	0.002	49.8	165.9	116.1	215.7
31	2MS6	0.24435610	0.006	-0.001	39.5	99.9	60.4	139.4
32	2SM6	0.24717808	0.006	0.001	56.6	134.3	77.7	190.9
33	3MN8	0.32053339	0.006	0.001	64.9	77.8	12.9	142.7
34	M8	0.32204556	0.001	0.001	52.4	352.5	300.1	44.8
35	3MS8	0.32486749	0.004	-0.002	161.0	59.4	258.4	220.5
36	M12	0.48306835	0.006	0.001	162.8	47.1	244.3	209.9

FINAL RESULTS IN CURRENT ELLIPSE FORM, WITH NODAL CORRECTIONS, SCALING UP FOR FILTER COMPENSATION

001053 01211 275

	NAME	FREQUENCY	MAJOR	MINOR	INC.	G	G+	G-
1	Z0	0.0	0.120	0.0	124.5	-0.0	235.5	124.5
2	MM	0.00151215	0.112	0.001	127.4	250.3	122.9	17.8
3	MSF	0.00282193	0.066	0.004	142.3	211.4	69.2	353.7
4	2Q1	0.03570635	0.031	-0.011	34.6	119.1	84.6	153.7
5	Q1	0.03721850	0.034	-0.004	172.3	334.2	161.9	146.5
6	O1	0.03873065	0.128	-0.061	146.5	312.2	165.8	98.7
7	NO1	0.04026859	0.028	0.006	141.2	15.4	234.2	156.5
8	K1	0.04178074	0.194	-0.065	135.1	346.5	211.4	121.6
9	J1	0.04329290	0.033	-0.020	149.8	7.9	218.1	157.7
10	001	0.04483084	0.026	-0.013	61.8	242.3	180.4	304.1
11	MNS2	0.07617730	0.016	-0.004	72.4	24.9	312.5	97.3
12	MU2	0.07768947	0.021	-0.006	65.2	262.0	196.8	327.2
13	N2	0.07899922	0.020	-0.003	156.2	320.2	164.0	116.4
14	M2	0.08051139	0.074	0.020	66.4	284.5	218.1	350.9
15	L2	0.08202350	0.016	0.005	111.8	5.4	253.6	117.2
16	S2	0.08333331	0.039	0.004	70.2	299.0	228.8	9.2
17	KJ2	0.08507359	0.025	-0.014	92.0	298.0	206.0	30.1
18	2SM2	0.08615524	0.008	-0.002	60.1	190.4	130.3	250.6
19	MO3	0.11924207	0.007	0.002	33.6	101.8	68.2	135.4
20	M3	0.12076706	0.009	-0.007	156.0	141.1	345.1	297.1
21	MK3	0.12229204	0.013	-0.007	166.0	236.5	70.5	42.4
22	SK3	0.12511408	0.010	0.001	110.3	135.7	25.4	246.0
23	MN4	0.15951055	0.002	-0.002	134.9	261.1	126.2	35.9
24	M4	0.16102278	0.007	-0.004	22.3	257.8	235.5	280.0
25	SN4	0.16233259	0.007	-0.003	1.4	116.8	115.4	118.3
26	MS4	0.16384465	0.006	-0.003	53.2	326.6	273.4	19.8
27	S4	0.16666669	0.007	-0.005	16.4	110.9	94.5	127.3
28	2MN6	0.24002194	0.008	0.000	30.9	325.9	295.1	356.9
29	M6	0.24153417	0.002	-0.001	163.7	26.7	223.0	190.4
30	MSN6	0.24234399	0.003	-0.002	86.4	202.3	115.9	288.6
31	2MS6	0.24435610	0.005	0.000	58.0	284.9	226.9	342.9
32	2SM6	0.24717808	0.004	0.001	142.6	140.5	357.9	283.0
33	3MN8	0.32053339	0.001	0.001	77.7	75.9	358.2	153.6
34	M8	0.32204556	0.003	0.002	135.9	320.1	184.2	96.0
35	3MS8	0.32486749	0.007	-0.001	39.9	342.7	302.8	22.8
36	M12	0.48306835	0.003	-0.002	178.6	265.3	86.7	83.9

RAW RESULTS

001091 01211 275
NO. PTS= 1323 NO. VALID X,Y PTS= 1323 1323

START = 12.00 HRS 11/ 2/75 MID = 1.00 HRS 11/ 3/75 END = 14.00 HRS 7/ 4/75

	CON	CYC/HR	CX	ERR	SX	ERR	CY	ERR	SY	ERR
1	Z0	0.0	-0.04	0.00	0.0	0.00	-0.00	0.00	0.0	0.00
2	MM	0.00151215	-0.01	0.01	-0.03	0.01	0.00	0.01	0.01	0.01
3	MSF	0.00282193	0.02	0.01	0.02	0.01	-0.02	0.01	-0.03	0.01
4	2Q1	0.03570635	-0.01	0.01	0.00	0.01	-0.00	0.01	0.01	0.01
5	Q1	0.03721850	0.02	0.01	-0.01	0.01	0.00	0.01	-0.00	0.01
6	O1	0.03873065	-0.07	0.01	0.05	0.01	0.04	0.01	0.03	0.01
7	NO1	0.04026859	0.01	0.01	-0.01	0.01	-0.01	0.01	0.01	0.01
8	K1	0.04178074	0.08	0.01	0.12	0.01	0.00	0.01	-0.05	0.01
9	J1	0.04329290	0.01	0.01	-0.01	0.01	-0.01	0.01	0.01	0.01
10	OO1	0.04483084	0.00	0.01	-0.01	0.01	-0.02	0.01	0.01	0.01
11	MNS2	0.07617730	-0.02	0.01	-0.00	0.01	0.00	0.01	0.01	0.01
12	MU2	0.07768947	-0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01
13	N2	0.07899922	0.00	0.01	-0.03	0.01	-0.01	0.01	-0.01	0.01
14	M2	0.08051139	-0.05	0.01	0.01	0.01	-0.06	0.01	-0.00	0.01
15	L2	0.08202350	0.00	0.01	-0.00	0.01	0.01	0.01	-0.00	0.01
16	S2	0.08333331	0.01	0.01	-0.01	0.01	-0.00	0.01	-0.04	0.01
17	KJ2	0.08507359	0.00	0.01	-0.00	0.01	0.01	0.01	-0.01	0.01
18	2SM2	0.08615524	0.01	0.01	0.00	0.01	0.00	0.01	-0.00	0.01
19	MO3	0.11924207	-0.01	0.01	0.00	0.01	-0.00	0.01	0.01	0.01
20	M3	0.12076706	0.01	0.01	0.01	0.01	0.00	0.01	-0.01	0.01
21	MK3	0.12229204	0.00	0.01	0.01	0.01	0.00	0.01	-0.00	0.01
22	SK3	0.12511408	0.00	0.01	0.01	0.01	0.01	0.01	-0.01	0.01
23	MN4	0.15951055	-0.00	0.01	-0.00	0.01	-0.00	0.01	0.01	0.01
24	M4	0.16102278	-0.00	0.01	0.01	0.01	0.01	0.01	-0.00	0.01
25	SN4	0.16233259	-0.00	0.01	-0.01	0.01	0.00	0.01	-0.00	0.01
26	MS4	0.16384465	-0.00	0.01	0.00	0.01	-0.00	0.01	0.00	0.01
27	S4	0.16666669	-0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
28	2MN6	0.24002194	0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
29	M6	0.24153417	-0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
30	MSN6	0.24284399	0.00	0.01	-0.00	0.01	0.00	0.01	-0.00	0.01
31	2MS6	0.24435610	0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
32	2SM6	0.24717808	0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
33	3MN8	0.32053339	-0.00	0.01	-0.00	0.01	-0.00	0.01	0.00	0.01
34	M8	0.32204556	0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
35	3MS8	0.32486749	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
36	M12	0.48306835	-0.00	0.01	0.00	0.01	-0.00	0.01	0.00	0.01

AVX= -0.05 SDX= 0.22 RMS(X-ER)= 0.18082 MTX COND=0.7736
AVY= -0.00 SDY= 0.19 RMS(Y-ER)= 0.17382 MTX COND=0.7736

FINAL RESULTS IN CURRENT ELLIPSE FORM.WITH NODAL CORRECTIONS.SCALING UP FOR FILTER COMPENSATION

001091 01211 275

	NAME	FREQUENCY	MAJOR	MINOR	INC.	G	G+	G-
1	ZO	0.0	0.044	0.0	2.2	180.0	177.8	182.2
2	MM	0.00151215	0.033	-0.000	157.8	240.0	82.3	37.8
3	MSF	0.00282193	0.049	-0.007	126.0	194.3	68.3	320.4
4	2Q1	0.03570635	0.014	-0.007	64.2	91.5	27.2	155.7
5	Q1	0.03721850	0.027	0.001	7.5	122.1	114.6	129.6
6	O1	0.03873065	0.094	-0.049	166.5	300.6	134.1	107.1
7	NO1	0.04026859	0.019	-0.000	136.2	117.4	341.2	253.6
8	K1	0.04178074	0.154	-0.031	161.7	340.9	179.2	142.7
9	J1	0.04329290	0.022	-0.004	132.9	41.9	269.0	174.8
10	001	0.04483084	0.023	-0.007	101.1	220.8	119.7	321.9
11	MNS2	0.07617730	0.021	-0.011	158.2	24.1	226.0	182.3
12	MU2	0.07768947	0.014	-0.009	139.8	71.7	291.9	211.6
13	N2	0.07899922	0.030	-0.013	10.1	170.4	160.3	180.5
14	M2	0.08051139	0.080	0.013	44.5	247.2	202.8	291.7
15	L2	0.08202350	0.010	-0.000	75.8	64.4	348.6	140.3
16	S2	0.08333331	0.046	-0.009	76.7	301.2	224.5	17.9
17	KJ2	0.08507359	0.011	-0.002	67.7	316.6	248.9	24.3
18	2SM2	0.08615524	0.011	-0.003	5.8	5.3	359.5	11.1
19	MO3	0.11924207	0.010	-0.005	22.6	157.8	135.2	180.4
20	M3	0.12076706	0.012	-0.008	11.1	24.3	13.2	35.3
21	MK3	0.12229204	0.008	-0.005	122.1	290.0	168.0	52.1
22	SK3	0.12511408	0.012	-0.007	82.5	335.5	252.9	58.0
23	MN4	0.15951055	0.009	-0.001	95.7	96.6	0.9	192.3
24	M4	0.16102278	0.014	-0.006	135.0	324.9	189.8	99.9
25	SN4	0.16233259	0.007	0.002	32.3	269.9	237.6	302.2
26	MS4	0.16384465	0.008	-0.003	34.5	129.8	95.3	164.3
27	S4	0.16666669	0.017	-0.005	12.0	140.0	127.9	152.0
28	2MN6	0.24002194	0.003	-0.001	64.6	280.2	215.6	344.7
29	M6	0.24153417	0.005	-0.001	68.1	247.0	178.9	315.1
30	MSN6	0.24284399	0.007	-0.002	87.6	270.9	183.3	358.5
31	2MS6	0.24435610	0.005	-0.001	14.6	273.8	259.2	288.5
32	2SM6	0.24717808	0.005	-0.003	43.5	295.7	252.2	339.1
33	3MN8	0.32053339	0.003	-0.000	5.3	207.6	202.3	212.9
34	M8	0.32204556	0.004	-0.001	126.8	193.9	67.1	320.6
35	3MS8	0.32486749	0.008	-0.003	18.0	80.4	62.4	98.4
36	M12	0.48306835	0.006	0.000	52.1	173.0	121.0	225.1

FINAL RESULTS IN CURRENT ELLIPSE FORM, WITH NODAL CORRECTIONS, SCALING UP FOR FILTER COMPENSATION

002009 0202S1174

	NAME	FREQUENCY	MAJOR	MINOR	INC.	G	G+	G-
1	Z0	0.0	0.399	0.0	109.6	-0.0	250.4	109.6
2	MM	0.00151215	0.126	-0.012	137.0	165.5	28.5	302.4
3	MSF	0.00232193	0.241	-0.079	126.2	153.9	27.8	280.1
4	2Q1	0.03570635	0.044	0.019	75.2	133.8	58.6	209.0
5	Q1	0.03721850	0.039	-0.013	36.4	33.5	357.1	69.9
6	O1	0.03873065	0.115	-0.020	136.1	323.3	187.3	99.4
7	NO1	0.04026859	0.076	-0.023	48.4	213.2	164.9	261.6
8	K1	0.04178074	0.207	-0.120	127.3	334.2	206.9	101.5
9	J1	0.04329290	0.058	-0.020	153.7	276.5	122.8	70.1
10	OO1	0.04483084	0.046	-0.016	90.3	313.8	223.5	44.0
11	MNS2	0.07617730	0.038	-0.022	93.5	123.7	30.2	217.2
12	MU2	0.07768947	0.035	-0.023	137.4	211.4	74.0	348.8
13	N2	0.07899922	0.014	0.011	38.7	119.0	80.3	157.7
14	M2	0.08051139	0.129	-0.019	30.8	235.0	204.2	265.9
15	L2	0.08202350	0.051	-0.011	145.4	267.8	122.3	53.2
16	S2	0.08333331	0.058	-0.040	37.5	272.6	235.1	310.2
17	2SM2	0.08615524	0.089	-0.041	33.9	154.5	120.7	188.4
18	MO3	0.11924207	0.014	-0.008	31.2	243.8	212.7	275.0
19	M3	0.12076706	0.046	-0.023	31.2	102.8	71.5	134.0
20	MK3	0.12229204	0.013	0.006	52.2	223.0	170.7	275.2
21	SK3	0.12511408	0.021	0.001	88.0	43.7	315.8	131.7
22	MN4	0.15951055	0.031	-0.003	62.5	214.2	151.7	276.7
23	M4	0.16102278	0.024	-0.004	157.8	107.6	309.9	265.4
24	SN4	0.16233259	0.024	-0.012	2.6	50.2	47.5	52.8
25	MS4	0.16384465	0.021	-0.007	147.5	284.5	137.0	71.9
26	S4	0.16666669	0.027	-0.003	12.7	30.2	17.5	42.9
27	2MN6	0.24002194	0.011	-0.001	121.1	320.1	199.0	81.2
28	M6	0.24153417	0.016	0.001	159.1	326.1	167.1	125.2
29	MSN6	0.24284399	0.015	-0.007	159.0	330.8	171.8	129.8
30	2MS6	0.24435610	0.014	0.002	179.1	336.7	157.6	155.8
31	2SM6	0.24717808	0.018	-0.009	49.3	16.5	327.2	65.8
32	3MN8	0.32053339	0.004	-0.001	157.8	87.6	289.8	245.4
33	M8	0.32204556	0.007	-0.000	82.7	120.6	37.9	203.3
34	3MS8	0.32486749	0.016	0.002	0.9	209.5	208.6	210.4
35	M12	0.48306835	0.017	-0.007	174.5	324.8	150.4	139.3

FINAL RESULTS IN CURRENT ELLIPSE FORM, WITH NODAL CORRECTIONS, SCALING UP FOR FILTER COMPENSATION

002009 012 7 175

	NAME	FREQUENCY	MAJOR	MINOR	INC.	G	G+	G-
1	Z0	0.0	0.486	0.0	105.4	-0.0	254.6	105.4
2	MM	0.00151215	0.260	0.130	0.8	311.6	310.8	312.4
3	MSF	0.00282193	0.108	0.010	170.4	191.5	21.1	1.9
4	2Q1	0.03570635	0.072	-0.015	29.9	234.6	204.7	264.6
5	Q1	0.03721850	0.022	0.002	172.8	353.8	181.0	166.6
6	O1	0.03873065	0.095	-0.043	115.6	307.0	191.4	62.6
7	NO1	0.04026859	0.023	-0.009	113.7	342.2	228.5	96.0
8	K1	0.04178074	0.165	-0.096	137.5	350.3	212.7	127.8
9	J1	0.04329290	0.021	-0.008	42.8	40.6	357.8	83.4
10	OO1	0.04483084	0.033	0.003	138.0	68.4	290.4	206.4
11	MNS2	0.07617730	0.030	0.015	85.1	318.8	233.7	44.0
12	MU2	0.07768947	0.041	-0.021	22.2	103.3	81.1	125.5
13	N2	0.07899922	0.028	0.011	76.3	309.7	233.4	26.0
14	M2	0.08051139	0.191	-0.078	21.1	229.7	208.6	250.8
15	L2	0.08202350	0.024	0.003	163.1	10.5	207.4	173.6
16	S2	0.08333331	0.059	-0.038	74.1	295.7	221.6	9.8
17	KJ2	0.08507359	0.053	-0.046	178.2	337.4	159.2	155.6
18	2SM2	0.08615524	0.023	0.006	120.1	26.3	266.2	146.4
19	MO3	0.11924207	0.018	-0.000	166.2	311.5	145.3	117.8
20	M3	0.12076706	0.016	-0.010	93.4	159.9	66.5	253.4
21	MK3	0.12229204	0.029	-0.021	64.5	51.4	346.9	115.9
22	SK3	0.12511408	0.019	-0.000	124.1	84.6	320.5	208.6
23	MN4	0.15951055	0.020	-0.006	57.9	269.0	211.1	326.8
24	M4	0.16102278	0.027	0.005	30.4	51.4	21.0	81.8
25	SN4	0.16233259	0.013	-0.006	92.3	74.1	341.8	166.3
26	MS4	0.16384465	0.014	-0.003	66.1	236.0	169.9	302.2
27	S4	0.16656659	0.014	0.002	150.9	282.2	131.3	73.0
28	2MN6	0.24002194	0.014	0.001	72.2	273.0	200.8	345.1
29	M6	0.24153417	0.008	-0.001	106.1	55.8	309.8	161.9
30	MSN6	0.24284399	0.013	0.000	20.9	258.2	237.4	279.1
31	2MS6	0.24435610	0.006	-0.001	3.8	293.1	289.3	297.0
32	2SM6	0.24717808	0.009	-0.005	133.3	119.9	346.6	253.2
33	3MN8	0.32053339	0.008	-0.002	180.0	164.3	344.3	344.2
34	M8	0.32204556	0.006	-0.000	157.4	223.2	65.8	20.5
35	3MS8	0.32486749	0.012	-0.001	39.4	58.5	19.2	97.9
36	M12	0.48306835	0.012	0.002	16.3	76.6	60.3	92.8

RAW RESULTS

002015 01612 275
NO. PTS= 1297 NO. VALID X,Y PTS= 1297 1297

START = 16.00 HRS 12/ 2/75 MID = 16.00 HRS 11/ 3/75 END = 16.00 HRS 7/ 4/75

	CON	CYC/HR	CX	ERR	SX	ERR	CY	ERR	SY	ERR
1	Z0	0.0	-0.02	0.01	0.0	0.00	0.14	0.01	0.0	0.00
2	MM	0.00151215	-0.07	0.01	-0.07	0.01	0.05	0.01	0.20	0.01
3	MSF	0.00282193	0.08	0.01	-0.08	0.01	-0.07	0.01	0.07	0.01
4	2Q1	0.03570635	0.00	0.01	-0.01	0.01	0.00	0.01	0.02	0.01
5	Q1	0.03721850	0.02	0.01	0.00	0.01	-0.01	0.01	-0.00	0.01
6	O1	0.03873065	0.01	0.01	-0.05	0.01	-0.03	0.01	0.01	0.01
7	NO1	0.04026859	-0.00	0.01	-0.00	0.01	-0.00	0.01	0.01	0.01
8	K1	0.04178074	-0.08	0.01	0.02	0.01	0.07	0.01	0.06	0.01
9	J1	0.04329290	0.01	0.01	0.00	0.01	0.00	0.01	-0.00	0.01
10	OO1	0.04483084	-0.01	0.01	-0.01	0.01	-0.01	0.01	0.02	0.01
11	MNS2	0.07617730	-0.01	0.01	-0.01	0.01	0.00	0.01	-0.01	0.01
12	MU2	0.07768947	0.02	0.01	-0.01	0.01	-0.00	0.01	-0.02	0.01
13	N2	0.07999922	0.02	0.01	-0.01	0.01	0.01	0.01	-0.04	0.01
14	M2	0.08051139	-0.06	0.01	0.05	0.01	-0.05	0.01	0.10	0.01
15	L2	0.08202350	-0.04	0.01	0.02	0.01	0.02	0.01	0.03	0.01
16	S2	0.08333331	-0.05	0.01	-0.02	0.01	-0.06	0.01	0.04	0.01
17	KJ2	0.08507359	-0.02	0.01	0.00	0.01	0.01	0.01	0.00	0.01
18	2SM2	0.08615524	-0.01	0.01	-0.00	0.01	-0.01	0.01	0.02	0.01
19	MO3	0.11924207	-0.00	0.01	-0.01	0.01	-0.00	0.01	-0.00	0.01
20	M3	0.12076706	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01
21	MK3	0.12229204	-0.01	0.01	0.00	0.01	-0.01	0.01	0.01	0.01
22	SK3	0.12511408	0.01	0.01	0.00	0.01	-0.00	0.01	-0.00	0.01
23	MN4	0.15951055	0.01	0.01	0.01	0.01	0.00	0.01	-0.01	0.01
24	M4	0.16102278	-0.01	0.01	0.00	0.01	0.00	0.01	-0.00	0.01
25	SN4	0.16233259	-0.01	0.01	-0.01	0.01	-0.00	0.01	-0.01	0.01
26	MS4	0.16384465	0.01	0.01	-0.00	0.01	0.00	0.01	-0.01	0.01
27	S4	0.16666669	-0.01	0.01	-0.01	0.01	0.00	0.01	0.00	0.01
28	2MN6	0.24002194	-0.00	0.01	0.00	0.01	-0.00	0.01	-0.01	0.01
29	M6	0.24153417	-0.01	0.01	0.00	0.01	-0.00	0.01	-0.00	0.01
30	MSN6	0.24284399	-0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
31	2MS6	0.24435610	0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
32	2SM6	0.24717908	-0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
33	3MN8	0.32053339	0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
34	M8	0.32204556	0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
35	3MS8	0.32486749	0.00	0.01	-0.00	0.01	-0.00	0.01	-0.00	0.01
36	M12	0.48306835	-0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01

AVX= -0.03 SDX= 0.32 RMS(X-ER)= 0.28310 MTX COND=0.7198
AVY= 0.14 SDY= 0.34 RMS(Y-ER)= 0.27669 MTX COND=0.7198

FINAL RESULTS IN CURRENT ELLIPSE FORM, WITH NODAL CORRECTIONS, SCALING UP FOR FILTER COMPENSATION

002015 01612 275

	NAME	FREQUENCY	MAJOR	MINOR	INC.	G	G+	G-
1	ZO	0.0	0.140	0.0	99.4	-0.0	260.6	99.4
2	MM	0.00151215	0.222	-0.045	114.7	253.2	138.5	7.9
3	MSF	0.00282193	0.150	0.002	140.0	108.9	329.0	248.9
4	2Q1	0.03570635	0.021	0.004	112.9	262.7	149.9	15.6
5	Q1	0.03721850	0.021	-0.003	160.4	192.8	32.3	353.2
6	O1	0.03873065	0.057	-0.032	150.0	290.3	140.4	80.3
7	NO1	0.04026859	0.011	-0.005	90.4	98.9	8.5	189.4
8	K1	0.04178074	0.114	-0.059	131.2	346.3	215.1	117.5
9	J1	0.04329290	0.011	-0.002	25.2	146.5	121.3	171.7
10	OO1	0.04493094	0.025	-0.008	99.4	59.2	319.7	158.6
11	MNS2	0.07617730	0.012	0.010	43.2	251.9	208.6	295.1
12	MU2	0.07768947	0.026	-0.015	41.0	109.5	68.6	150.5
13	N2	0.07899922	0.042	-0.019	71.8	252.9	181.1	324.7
14	M2	0.08051139	0.138	-0.026	54.7	272.4	217.7	327.0
15	L2	0.08202350	0.067	-0.051	167.4	162.6	355.2	330.0
16	S2	0.08333331	0.089	-0.045	60.9	280.1	219.2	341.1
17	KJ2	0.08507359	0.021	-0.005	154.4	357.6	203.1	152.0
18	2SM2	0.08615524	0.027	-0.012	85.9	111.8	25.9	197.6
19	MO3	0.11924207	0.010	-0.001	20.0	262.1	242.1	282.2
20	M3	0.12076706	0.008	-0.003	11.6	63.7	52.1	75.3
21	MK3	0.12229204	0.018	-0.011	51.9	136.3	84.4	188.2
22	SK3	0.12511408	0.008	-0.000	152.9	185.1	32.2	338.0
23	MN4	0.15951055	0.017	-0.010	144.6	256.6	112.0	41.3
24	M4	0.16102278	0.017	-0.001	166.3	342.8	176.5	149.2
25	SN4	0.16233259	0.021	0.003	32.2	247.4	215.2	279.7
26	MS4	0.16384465	0.018	-0.007	27.3	329.0	301.7	356.3
27	S4	0.16656659	0.020	-0.001	161.8	46.9	245.1	208.7
28	2MN6	0.24002194	0.013	0.002	99.6	238.4	138.8	338.0
29	M6	0.24153417	0.008	0.004	174.4	336.8	162.4	151.3
30	MSN6	0.24284399	0.005	-0.000	27.6	203.6	176.0	231.2
31	2MS6	0.24435610	0.007	-0.003	58.6	253.7	195.2	312.3
32	2SM6	0.24717808	0.005	-0.000	37.6	231.1	193.4	268.7
33	3MN8	0.32053339	0.002	-0.001	109.0	210.6	101.5	319.6
34	M8	0.32204556	0.006	-0.003	82.0	206.1	124.2	288.1
35	3MS8	0.32486749	0.005	-0.003	50.8	248.0	197.2	298.8
36	M12	0.48306835	0.007	-0.004	5.4	151.2	145.8	156.6

FINAL RESULTS IN CURRENT ELLIPSE FORM,WITH NODAL CORRECTIONS,SCALING UP FOR FILTER COMPENSATION

002175 016281174

	NAME	FREQUENCY	MAJOR	MINOR	INC.	G	G+	G-
1	ZO	0.0	0.073	0.0	166.1	-0.0	193.9	166.1
2	MM	0.00151215	0.086	0.001	130.3	55.3	285.0	185.5
3	MSF	0.00282193	0.069	0.009	133.1	189.2	56.1	322.3
4	2Q1	0.03570635	0.010	0.000	139.5	200.7	61.3	340.2
5	Q1	0.0372185C	0.008	-0.002	87.5	296.0	208.6	23.5
6	O1	0.03873065	0.077	-0.047	173.1	278.3	105.2	91.5
7	NO1	0.04026859	0.021	-0.003	25.2	143.5	118.3	168.8
8	K1	0.04178074	0.138	-0.107	160.1	314.8	154.7	114.9
9	J1	0.04329290	0.014	-0.009	136.6	184.0	47.4	320.6
10	001	0.04483084	0.028	-0.005	119.0	33.0	274.0	152.0
11	MNS2	0.07617730	0.005	0.002	45.4	349.8	304.4	35.2
12	MU2	0.07768947	0.012	-0.001	148.7	279.8	131.1	68.6
13	N2	0.07899922	0.025	-0.017	127.3	275.5	148.3	42.8
14	M2	0.08051139	0.077	-0.008	114.9	329.9	215.0	84.7
15	L2	0.08202350	0.017	-0.013	64.8	336.2	271.4	41.0
16	S2	0.08333331	0.027	0.002	128.4	349.7	221.3	118.1
17	KJ2	0.08507359	0.015	-0.002	157.0	87.7	290.8	244.7
18	2SM2	0.08615524	0.014	-0.005	66.1	330.0	263.9	36.1
19	MO3	0.11924207	0.005	-0.002	63.7	317.1	253.4	20.8
20	M3	0.12076706	0.004	0.000	171.9	211.5	39.6	23.4
21	MK3	0.12229204	0.013	-0.006	91.3	111.1	19.8	202.4
22	SK3	0.12511408	0.005	-0.001	152.9	321.4	168.5	114.4
23	MN4	0.15951055	0.004	-0.001	137.9	9.1	231.1	147.0
24	M4	0.16102278	0.006	-0.001	164.0	267.5	103.6	71.5
25	SN4	0.16233259	0.006	-0.002	31.5	193.8	162.3	225.3
26	MS4	0.16384465	0.004	0.000	67.6	100.9	33.3	168.5
27	S4	0.16666669	0.003	-0.001	149.1	51.9	262.8	201.0
28	2MN6	0.24002194	0.003	0.001	1.9	354.7	352.8	356.6
29	M6	0.24153417	0.005	-0.000	42.0	80.3	38.3	122.3
30	MSN6	0.24284399	0.002	-0.001	175.1	121.8	306.7	297.0
31	2MS6	0.24435610	0.004	-0.000	34.8	39.6	4.8	74.4
32	2SM6	0.24717808	0.004	-0.001	113.0	286.4	173.4	39.5
33	3MN8	0.32053339	0.003	-0.001	10.7	94.6	83.8	105.3
34	M8	0.32204556	0.003	0.000	8.6	206.0	197.5	214.6
35	3MS8	0.32486749	0.003	-0.002	154.2	193.6	39.4	347.8
36	M12	0.48306835	0.001	0.000	145.4	315.1	169.7	100.5

FINAL RESULTS IN CURRENT ELLIPSE FORM, WITH NODAL CORRECTIONS, SCALING UP FOR FILTER COMPENSATION

002200 01612 275

	NAME	FREQUENCY	MAJOR	MINOR	INC.	G	G+	G-
1	Z0	0.0	0.118	0.0	163.3	-0.0	196.7	163.3
2	MM	0.00151215	0.033	-0.004	110.7	188.9	78.2	299.6
3	MSF	0.00282193	0.032	0.022	68.7	142.2	73.5	210.9
4	2Q1	0.03570635	0.009	0.001	138.6	132.5	353.9	271.1
5	Q1	0.03721850	0.015	0.008	151.3	279.8	128.5	71.2
6	O1	0.03873065	0.071	-0.029	10.5	49.7	39.2	60.3
7	NO1	0.04026859	0.010	-0.004	103.3	181.1	77.8	284.4
8	K1	0.04178074	0.120	-0.062	171.9	298.6	126.7	110.4
9	J1	0.04329290	0.016	0.009	7.4	190.1	182.6	197.5
10	OO1	0.04483084	0.023	0.001	171.2	215.6	44.4	26.8
11	MNS2	0.07617730	0.018	-0.005	4.0	233.1	229.2	237.1
12	MU2	0.07768947	0.029	-0.016	47.9	269.6	221.7	317.5
13	N2	0.07899922	0.029	-0.012	172.8	234.7	61.9	47.5
14	M2	0.08051139	0.046	0.012	123.9	330.3	206.5	94.2
15	L2	0.08202350	0.030	-0.009	5.7	223.3	217.6	229.0
16	S2	0.08333331	0.056	-0.005	174.0	2.3	188.3	176.3
17	KJ2	0.08507359	0.051	-0.028	13.3	331.3	318.0	344.6
18	2SM2	0.08615524	0.016	-0.010	114.1	253.1	138.9	7.2
19	MO3	0.11924207	0.007	-0.002	69.1	112.2	43.2	181.3
20	M3	0.12076706	0.009	-0.006	40.3	141.8	101.5	182.1
21	MK3	0.12229204	0.007	-0.004	158.2	272.0	113.8	70.3
22	SK3	0.12511408	0.011	-0.003	159.2	253.0	93.7	52.2
23	MN4	0.15951055	0.005	-0.003	147.5	72.9	285.3	220.4
24	M4	0.16102278	0.021	-0.004	10.4	316.3	305.9	326.7
25	SN4	0.16233259	0.014	-0.001	147.8	166.8	19.0	314.6
26	MS4	0.16384455	0.011	-0.003	107.3	161.3	54.1	268.6
27	S4	0.16666669	0.008	-0.005	12.7	323.0	310.3	335.6
28	2MN6	0.24002194	0.008	-0.001	39.9	113.9	74.1	153.8
29	M6	0.24153417	0.008	0.002	33.7	72.9	39.3	106.5
30	MSN6	0.24284399	0.004	0.000	27.6	181.1	153.5	208.6
31	2MS6	0.24435610	0.007	0.001	22.0	208.9	186.9	230.9
32	2SM6	0.24717808	0.004	-0.001	38.9	109.3	70.4	148.1
33	3MN8	0.32053339	0.005	-0.003	59.0	192.7	133.7	251.7
34	M8	0.32204556	0.004	0.001	71.0	138.1	67.1	209.1
35	3MS8	0.32486749	0.006	-0.000	9.8	154.0	144.3	163.8
36	M12	0.48306835	0.004	-0.003	41.9	71.3	29.4	113.2